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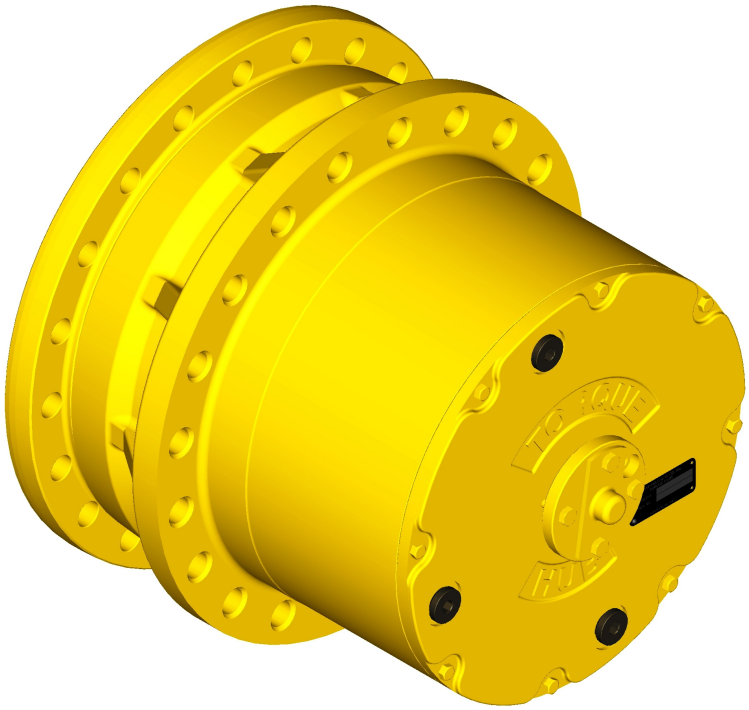
Torque-Hub® Planetary Final Drive
CT26C Service Manual



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Planetary Final Drive Service Manual
Content

	Introduction	4
	Brake Test	5
	Roll and Leak Test	9
	Tightening and Torquing Bolts	11
	Lubrication Information	12
	Seal Installation Instructions	14
Disassembly Instructions	Main Disassembly	18
	Output Planet Gear Disassembly	20
	Input Disconnect Coupling Disassembly	22
	Input Brake Disassembly	24
	Cover Disassembly	26
	Housing-Spindle Disassembly	28
	Intermediate Carrier Disassembly	31
	Input Carrier Disassembly	32
Assembly Instructions	Cover Subassembly	34
	Input Carrier Subassembly	36
	Intermediate Carrier Subassembly	38
	Housing Spindle Subassembly	40
	Input Disconnect Coupling Subassembly	42
	Output Planet Gear Subassembly	44
	Main Assembly	46
	Assembly Drawing	52
	Parts List	53
	Assembly Tools	55
General Information	Contact Information	71

Planetary Final Drive Service Manual
Introduction

This manual is a step-by-step guide to the disassembly and assembly of the CT26C Torque-Hub® units. It is designed for the customer or mechanic who is repairing this particular Torque-Hub® model.

Users of this manual should note that each part mentioned is followed by an identification number enclosed in parentheses. These part numbers may be referred to in the Parts List and Assembly Drawing sections of this manual.

Specialized tools used to assemble this unit are noted in the assembly procedures and diagrammed in the Assembly Tools section.

Users should familiarize themselves with the procedures for roll and leak testing, as well as bolt tightening and torquing found on the following three pages before starting any repairs.

Standard safety practices should be followed during the disassembly and assembly procedures described. Safety glasses and safety shoes should be worn, and heavy, heat resistant gloves should be used when handling heated components. Be especially alert when you see the word **CAUTION**. This indicates that a particular operation could cause personal injury if not performed properly or if certain safety procedures are not followed. The word **NOTE** is used to bring attention to certain procedures or helpful hints that will aid in the disassembly and assembly process.

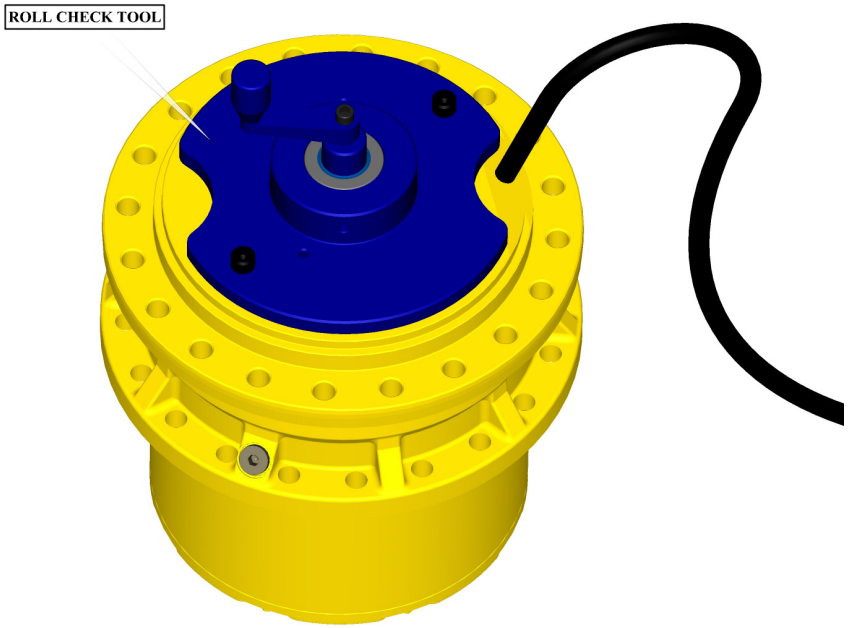
Planetary Final Drive Service Manual
Brake Test

The Brake Test

To perform a brake check, use a M12 x 1.5 metric fitting. Install a hydraulic hand pump with pressure gauge into brake port in spindle (1A) using metric thread fitting.

Place ROLL TEST Tool (refer to table on page 9) into input coupling

Apply 25 in-lbs torque.While trying to rotate tool, pump the handle on the hydraulic hand pump and increase the pressure until the brake releases. The brake is released when you are able to rotate the tool.



Record the release pressure. If brake does not release within limits shown in the brake chart on page 6, check to see if it has the proper number of springs using the **SPRING CHECKING PROCEDURE.** Increase to maximum pressure (refer to brake chart on page 6) and hold at that pressure for one minute. If the brake does not leak or lose pressure, the unit has passed the brake test. If brake loses pressure, attempt to repair leak using the leak repair procedure at end of this procedure.

While brake is still released, roll check the unit for one revolution of the output member by rotating the tool. Bleed off pressure slowly while rotating the ROLL TEST Tool.

Record the pressure at which the brake locks up. Using a clean rag, wipe off excess fluid from around brake port and install the pipe plug.

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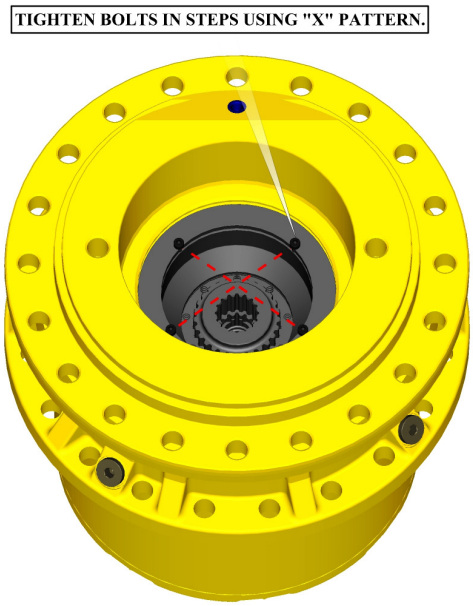
BRAKE CHART							
10th DIGIT IN MODEL CODE (INPUT BRAKE)	BRAKE PART NUMBER	NUMBER OF SPRINGS	RELEASE PRESSURE (psi)	FULL RELEASE PRESSURE (psi/bar)	MAXIMUM PRESSURE (psi/bar)	BRAKE TORQUE (in-lbs/N.m)	LOCKUP PRESSURE (psi)
1	902446A	11	94 TO 113	138/9.5	3000/207	3061/346	64 TO 83
2	902446B	16	135 TO 162	202/13.9	3000/207	4415/499	105 TO 132
3	902446C	19	158 TO 192	240/16.5	3000/207	5212/589	128 TO 162
4	902446G	13	110 TO 133	164/11.3	3000/207	3607/408	80 TO 103
0	No Brake						

SPRING CHECKING PROCEDURE:
Install four bolts into holes in brake piston as equally spaced as possible. Tighten bolts in steps using an 'X' pattern to ensure that brake piston remains straight while being compressed into brake cavity of spindle.



Carefully remove retaining ring from spindle. Slowly remove bolts from the input brake in steps using an 'X' pattern. Remove the cover plate from the end of the input brake and count the number of springs in brake. If number of springs matches the number in **BRAKE CHART**, go to the next step. If number of springs does not matches the number in the **BRAKE CHART** above, install the correct number of springs.

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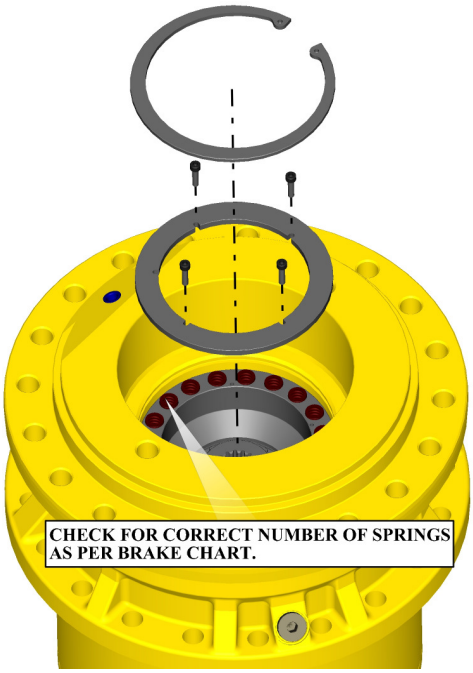

Install the Cover Plate using four bolts. Tighten bolts in steps using an ‘X’ pattern to ensure that brake piston remains straight while being compressed into brake cavity of spindle.

Install the large retaining ring into groove in spindle (1A) making sure that it is seated properly. Remove all remaining bolts from the brake piston and discard.

NOTE: USE CAUTION WHEN REMOVING BOLTS AS THEY ARE SUBJECT TO SPRING PRESSURE. MAKE SURE THE RETAINING RING IS SECURED BEFORE REMOVING BOLTS.

Re-test the input brake. If release and/or lockup pressures still do not match the brake chart, then contact the Oerlikon Fairfield service department.

BREAK LEAK REPAIR PROCEDURE:
Install four bolts into holes in Brake Piston as equally spaced as possible. Tighten bolts in steps using an 'X' pattern to ensure that Brake Piston remains straight while being compressed into brake cavity of Spindle.

Carefully remove Retaining Ring from Spindle. Using two eyebolts threaded into opposite holes in the Brake Piston, remove the Brake Piston from Spindle.

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Check O-rings, Backup Rings, and brake cavity in Spindle for damage. If no damage is found, then reinstall Input Brake according to Input Brake Installation Procedure under Main Assembly procedure and perform pressure test again. If brake still leaks, contact the Oerlikon Fairfield service department.

Reference: Sample Model CT26C_ _ _ _X_ _ _ _ _.The 'X' is the brake option (Model Code). Consult Oerlikon Fairfield for other brake options.

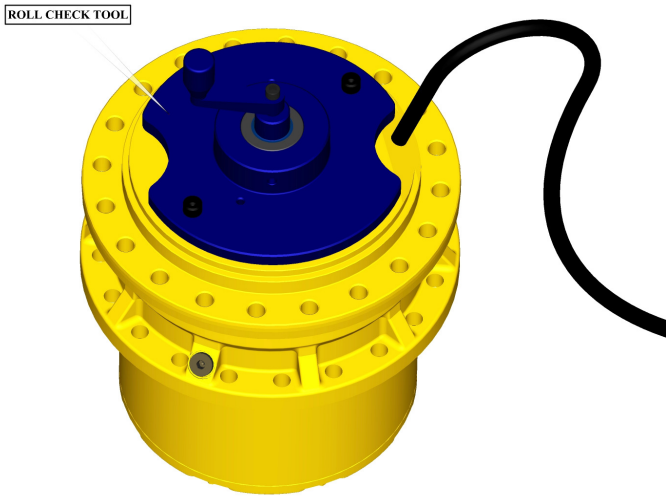
NOTE: Failure to perform this test may result in damaged or ineffective brake parts.

Planetary Final Drive Service Manual
Roll and Leak Test

Torque-Hub® units should always be roll and leak tested before disassembly (if possible) and after assembly to make sure the unit's gears, bearings, and seals are working properly. The following information briefly outlines what to look for when performing these tests.

The Roll Test

The purpose of the roll test is to determine if the unit's gears are rotating consistently, easily and properly. Release the brake by applying 400 Psi to the brake port. To perform a roll test, use the recommended tool from table below (or something equivalent) to apply constant rotational force to the input of the gearbox. If more drag is felt in the gears only at certain points, then the gears are not rolling consistently and easily and should be examined for improper installation or defects. Some gear packages roll with more difficulty than others. Do not be concerned if the gears in the unit seem to roll hard as long as they roll with *consistency*. Rotate the gearbox both clockwise and counterclockwise the same number of turns as the ratio of the unit. The gearbox ratio is the same number as the last three numbers on the ID tag.



Model code	Roll Test Tool
CT26C1BxxDxxx	T188492
CT26C11xxAxxx	T182969
CT26C11xx4xxx	T187845
CT26C11xx8xxx	T182226
CT26C12xx4xxx	T176237
CT26C14xxBxxx	T184035
CT26C17xx3xxx	T216738
CT26C18xx4xxx	T198122
CT26C21xxAxxx	T182969

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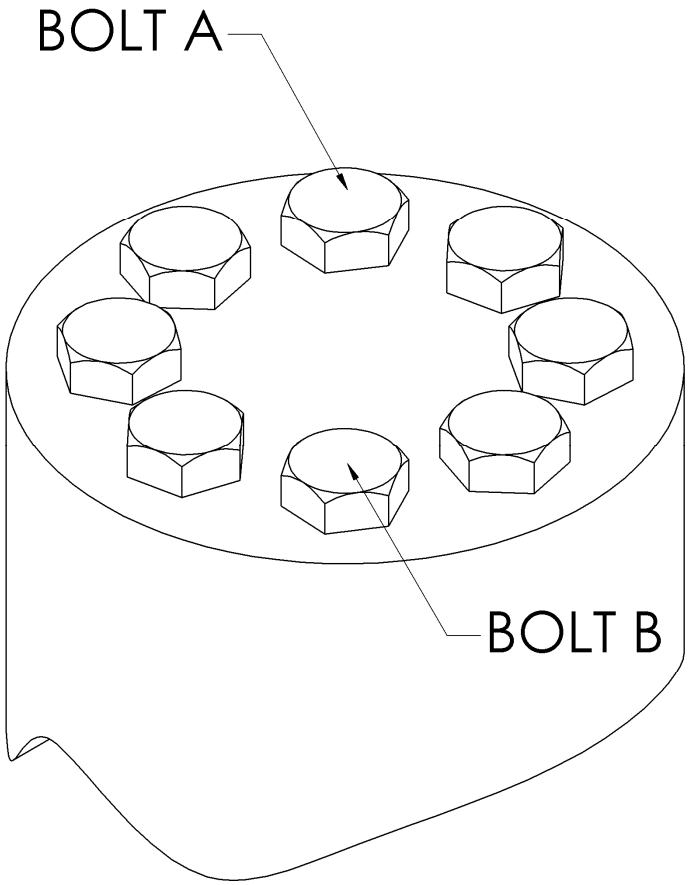
The Leak Test

The purpose of a leak test is to make sure the unit is airtight. To perform a leak test use the leak test fixture from the table below. If the tool is not available, the gearbox must be sealed to perform the test. This can be accomplished by assembling the sealed input device onto the gearbox at the input end and replace one of the oil plugs with an air chuck. DO NOT EXCEED 10 PSI PRESSURE DURING THE LEAK TEST. Higher pressure will create a false sealing effect in assemblies with lip-seals. The unit has a leak if the pressure gauge reading on your leak check fitting starts to fall after the gearbox has been pressurized and allowed to equalize. Leaks will most likely occur at the pipe plugs, the main seal or wherever o-rings or gaskets are located. The exact location of a leak can usually be detected by brushing a soap and water solution around the main seal and where the o-rings or gaskets meet on the exterior of the unit and then checking for air bubbles. If a leak is detected in a seal, o-ring, or gasket, the part must be replaced and the unit rechecked. Leak test at 10 psi for 20 minutes.

Model code	Leak Test Tool
CT26C1Bxxxxxx	T187059
CT26C11xxxxxx	T184729
CT26C12xxxxxx	T187059
CT26C14xxxxxx	T187059
CT26C17xxxxxx	T170238
CT26C18xxxxxx	T220225
CT26C21xxxxxx	T184729

Planetary Final Drive Service Manual
Tightening and Torquing Bolts

If an air impact wrench is used to tighten bolts, extreme care should be taken to ensure the bolts are not tightened beyond their specified torque. The following steps describe how to tighten and torque bolts or socket head cap screws in a bolt circle.



1. Tighten (but do not torque) bolt “A” until snug.
2. Go to the opposite side of the bolt circle and tighten bolt “B” until equally snug.
3. Crisscross around the bolt circle and tighten the remaining bolts.
4. Use a torque wrench to apply the specified torque to bolt “A”.
5. Using the same sequence, crisscross around the bolt circle and apply an equal torque to the remaining bolts.

Planetary Final Drive Service Manual
Lubrication Information

General Properties:

The lubricant used in most Torque-Hub® drives should be petroleum based gear fluid containing anti-oxidation, anti-foaming and extreme pressure additives. The lubricant should have a minimum viscosity index of 95 cst and maintain a minimum viscosity of 40 cst under normal operating conditions. Some applications require special considerations; consult the machine manufacturer and Oerlikon Fairfield for more additional information.

The table below lists the recommended viscosities for various ambient operating temperatures. These recommendations are based on temperature rise of 50° to 100°F at normal operating conditions.

	Differential Planetary		**Simple Planetary**	
Ambient Temperature	ISO Index	AGMA Lubricate Number	ISO Index	AGMA Lubricate Number
-40° to -5° F(1)	VG100	3EP	VG100	3EP
-5° to 40° F	VG150	4EP	VG100	3EP
40° to105° F	VG220/VG320	5EP/6EP	VG150/VG220	4EP/5EP
105° to 150° F(2)	VG460	7EP	VG320	6EP

Footnotes

1. For operation in this ambient temperature range, synthetic oil is recommended with a pour point of 10°F lower than the minimum ambient temperature.
2. For operation in this ambient temperature range, synthetic oil is recommended for proper lubricant life at elevated temperatures.

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Maintenance

Oil amounts for each series of Torque-Hub® drives are indicated in the appropriate series literature. An initial oil change should be made after the first 50 hours of operation. Subsequent oil changes should be made at 1,000 hour intervals or annually, whichever comes first.

Oil temperatures should be not higher than 160° to 180°F for continuous operation, and no higher than 200°F for intermittent operation. For special applications, high horsepower, high speeds or wide temperature changes, please consult Oerlikon Fairfield.

Oil Fill Level

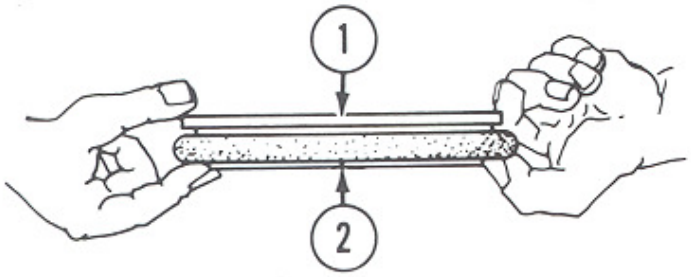
When the Torque-Hub® unit is mounted horizontally, unless otherwise specified, the gearbox should be filled half-full of oil. Consult the appropriate series literature for approximate fill volumes. Vertically mounted Torque-Hub® units may require special lubrication procedures. Please contact Oerlikon Fairfield for vertically mounted applications.

Planetary Final Drive Service Manual
Seal Installation

The seal installation tool can be purchased from MORCOR LTD at Sales@MORCORLTD.com part number MGT045.

To begin the procedure, all of the sealing components; Seal Rings (metal rings); O-Rings and the housings must be clean and free of Oil, Grease, Dirt or Dust. Always check to make sure that there are no nicks or burrs in the housing area that could damage the Load Ring during installation. The use of DENATURED ALCOHOL (also known as Wood Alcohol or Shellac Thinner) and a lint free cloth is recommended for cleaning all of these areas. **NOTE:** Follow all Material Safety Data Sheet guidelines.

After all components have been wiped clean and have dried, the O-Rings should be placed back on the Seal Rings in their proper position. The O-Rings must be seated completely and tightly on the Seal Ring. Always make sure that the O-rings are not twisted or distorted by inspecting the mold flash (seam) on the outside diameter to see that is running “true” with the circumference.



Eliminate O-Ring twist by gently pulling a section of the O Ring (2) rapidly away from the Seal Ring (1) and letting it “snap” back.

Warning: Do not place the Seal Rings face down on any hard or abrasive surface to accomplish this! Once the O-Rings are back on the Seal Rings, quickly swab out the housing with a clean lint free cloth generously soaked it with Denatured Alcohol. This is to temporarily lubricate the bore. Then, with the same cloth, quickly swab the outside (O- Ring area) of the seal half to temporarily lubricate the O-Ring.

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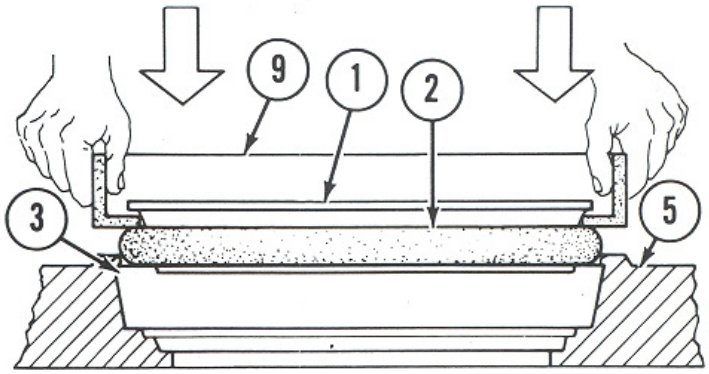
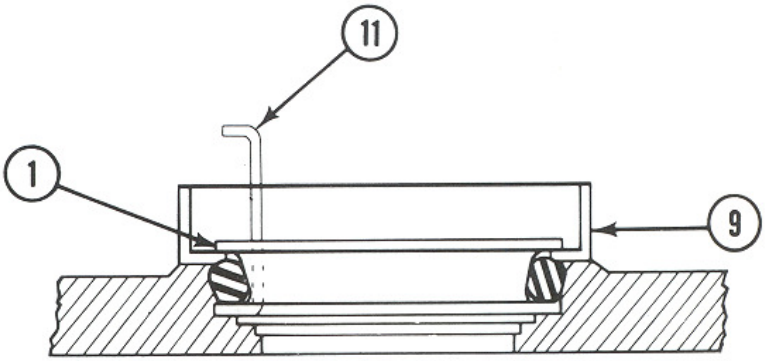
With all surfaces of the O Ring (2) wet with alcohol use the Installation Tool (9) to position the Seal Ring (1) and the O-Ring (2) squarely against the Housing (5) as shown. Use sudden and even pressure to pop (push) the Toric Ring under the Retaining Lip (3) of the housing.



NOTE: It is important for the O-ring as well as the housing bore to be wet with Alcohol during this process. Visually inspect the positioning of the O-Ring and Seal Ring relative to each other, as well as relative to the housing. Always make sure that everything is seated symmetrically. **NOTE:** Misaligned seals and improperly seated O-Rings can cause leakage or premature failure.



If small adjustments are necessary; do not push directly on the Seal Ring (1) use the Installation tool (9) to push down or use the Adjustment Tool (11) to pull up. **NOTE:** Never use sharp instruments such as screwdrivers. They can cause permanent damage to the O-Ring and/or Seal Ring, which may lead to rapid failure. For twists or obvious bulges in the O-Ring or if the Seal Ring is "riding up" on the O-Ring and cannot be adjusted, always remove the seal half and repeat the procedure, beginning with the cleaning process.

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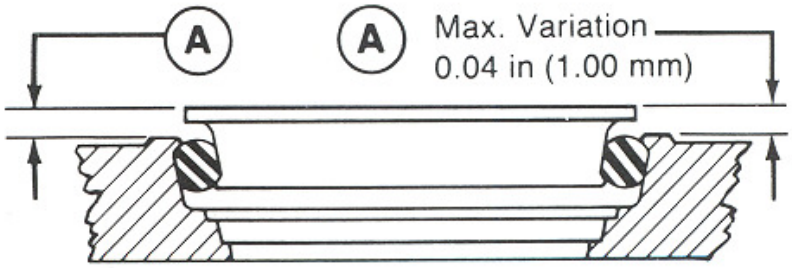
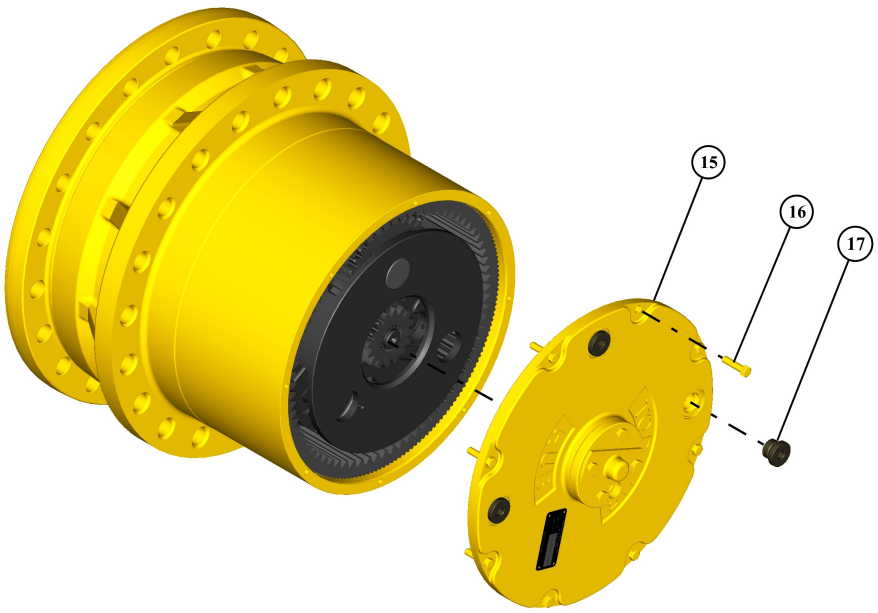
After a successful installation always wait a few minutes for the Alcohol to completely evaporate, before assembling. The Alcohol is necessary as a lubricant during the installation process, but for assembly the area must be clean and dry in order for the O- Ring to properly "crush" into its final position. After the two seal halves have been installed in their respective housings and just prior to assembly, the faces should be thoroughly cleaned with Denatured Alcohol. Next, apply a thin film of oil (EP90 the same oil that will be used to fill the assembly) to the faces of the Seal Rings with a clean lint free cloth. Warning: Be careful not to get oil on the O- Rings! The seal set is now ready to be drawn together in the assembled unit.



Check the assembled height (A) in a least four places spaced 90° apart.

DISASSEMBLY



1. Perform a roll check and a leak check prior to disassembling the unit.
2. Remove the two magnetic Pipe Plugs (17) and drain the oil out of the gearbox.

   NOTE: Record the condition and volume of the oil.
3. Remove Bolts (16) from Cover Subassembly.
4. Lift the Cover Subassembly off of the unit.

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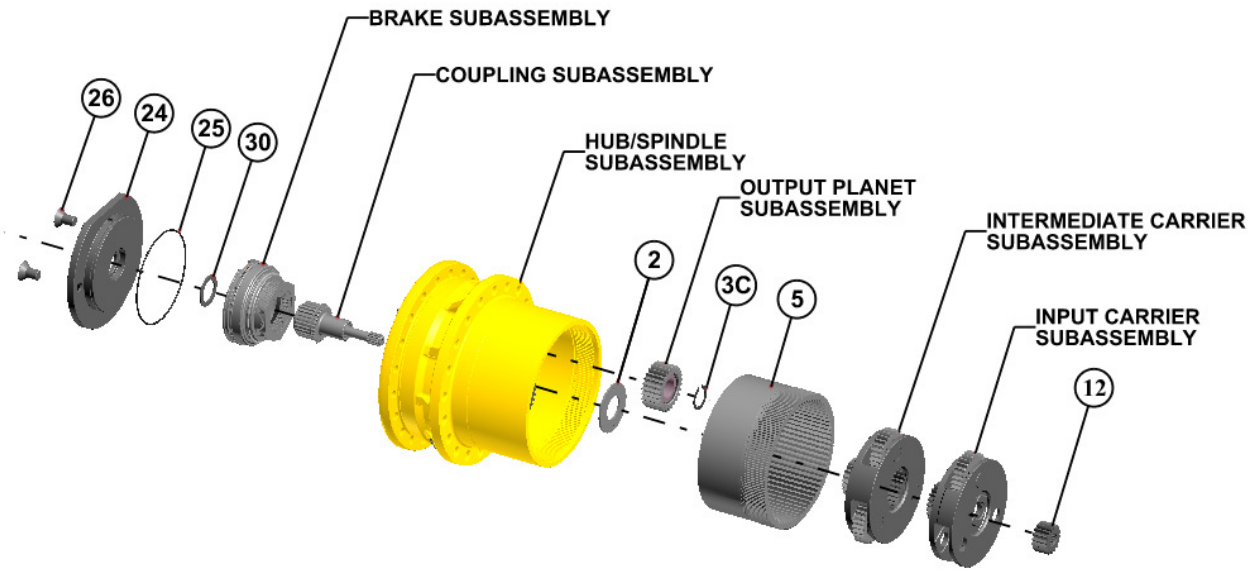


5. If Unit has Disengage then remove Sun Gear (12).

6. Lift out the Input Carrier Subassembly.

7. Remove Intermediate Carrier Subassembly.

8. Lift the Ring Gear (5) out of the Housing Spindle Subassembly.

CAUTION: Safety glasses must be worn during these next steps.

9. Remove the five External Retaining Rings (3C) that are holding the spindle Planet Gears (3A) in place.

10. Carefully pry the Planet Gears (3A) off of the spindle posts. Be careful to not damage the Thrust Spacer (2).

11. Remove Thrust Spacer (2) from Housing Spindle Subassembly.

NOTE: Skip steps 12,13 and 14 if unit does not have Adaptor Mounting (24).

12. Remove Adaptor Mount (24) from Housing Spindle Subassembly by uninstalling Bolts (26).

13. Remove Thrust Washer (30) from Adaptor Mount (24).

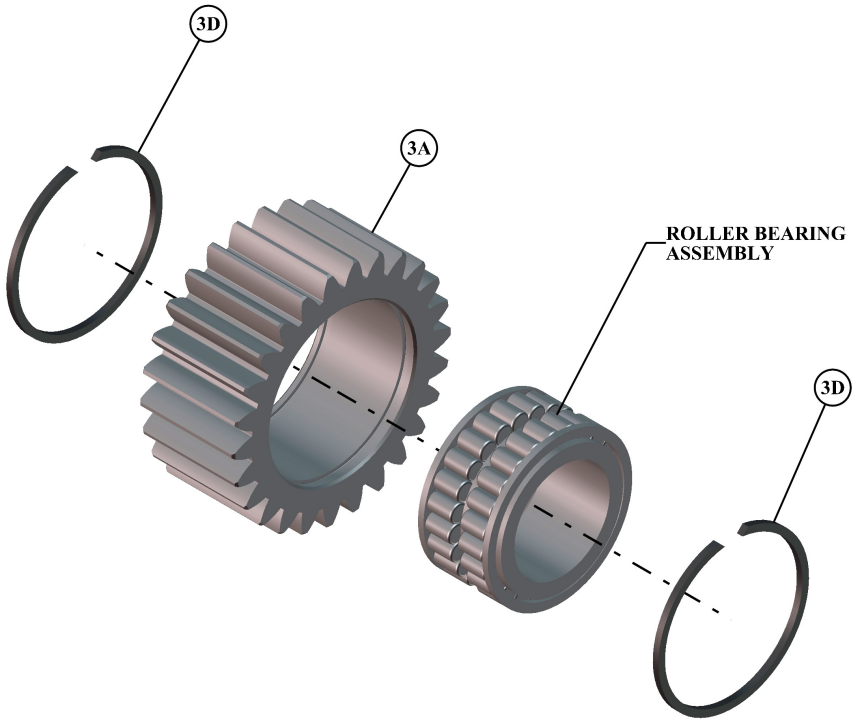
14. Remove the O-Ring (25) from groove in Adaptor Mount (24) and discard O-Ring.

15. Remove the Brake Subassembly out of Spindle Subassembly (Refer page 24 for Input Brake Disassembly).

16. Remove the Input Coupling Subassembly (21A) out of Spindle Subassembly.

This concludes the Main Disassembly.

Output Planet Gear Disassembly



CAUTION: Safety glasses must be worn during this next steps.

1. Place the Planet Gear Sub Assembly on bench.

2. Remove the upper Retaining Ring (3D) from groove of the Planet Gear (3A).

   NOTE: In Step below, slide rubber band around the rollers in bearing as it is removed. This rubber band prevents the rollers from falling off the Roller Bearing.

3. Remove the Roller Bearing assembly carefully.

4. Remove the lower Retaining Ring (3D) from groove of the Planet Gear (3A).

   NOTE: The Roller Bearings (3B) are pressed onto the Spindle (1A) and locked into the Planet Gears (3A). If the Planet Gears are damaged, or the Roller Bearings are damaged or worn then both parts must be replaced. The Planet Gears are also a matched set and if one is damaged all must be replaced.

This concludes the Output Planet Gear Disassembly.

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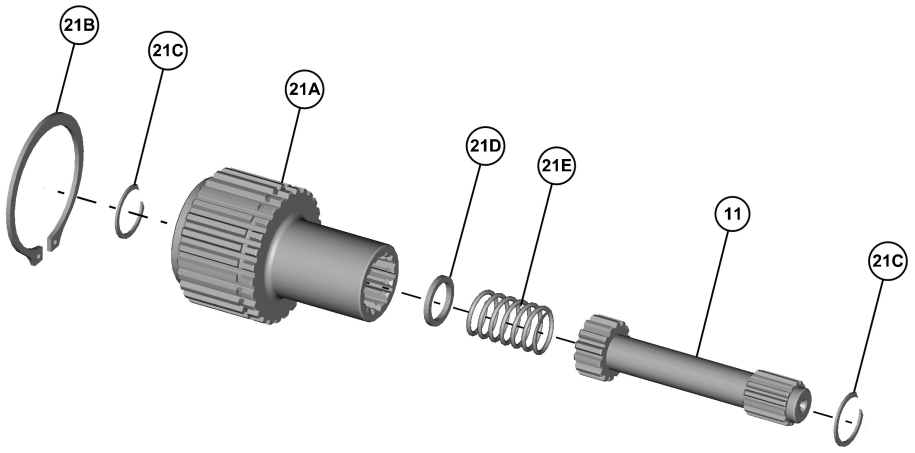
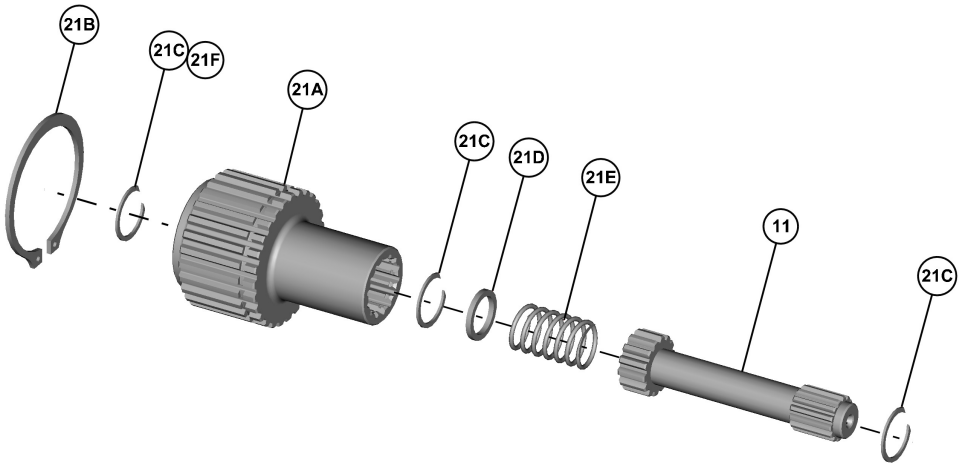
Input Disconnect Coupling Disassembly



DISENGAGE - COUPLING WITH TWO INTERNAL RETAINING RINGS



DISENGAGE - COUPLING WITH THREE INTERNAL RETAINING RINGS

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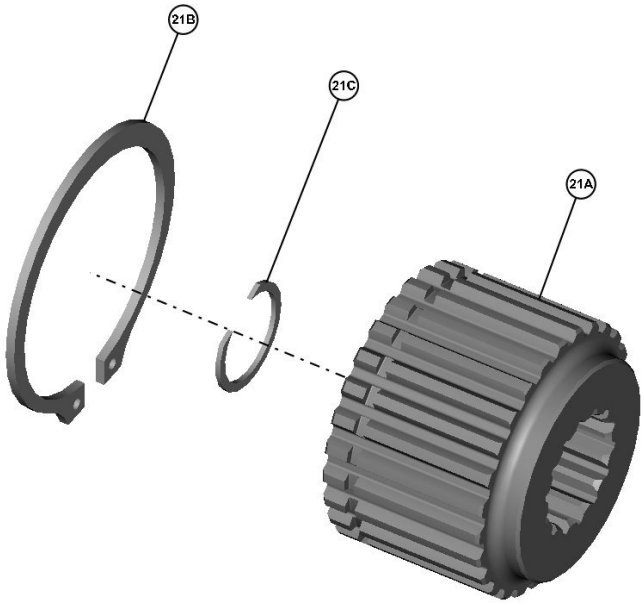


NON DISENGAGE - COUPLING WITH ONE INTERNAL RETAINING RING

CAUTION: Safety glasses must be worn during this next steps.

1. Using retaining ring pliers remove external Retaining Ring (21B) from O.D. groove of Input Coupling (21A), if required.

2. Remove internal Retaining Ring (21C) from the retaining ring groove of Coupling (21A) (Applicable for only Non Disengage Coupling Disassembly).

   NOTE: Skip below steps for Non Disengage Coupling Disassembly.

3. Remove internal Retaining Ring (21C) from the retaining ring groove on long shank end of Coupling (21A).

4. Remove Input Shaft (11) from Coupling (21A). Remove Spring (21E) from long shank end of Coupling (21A).

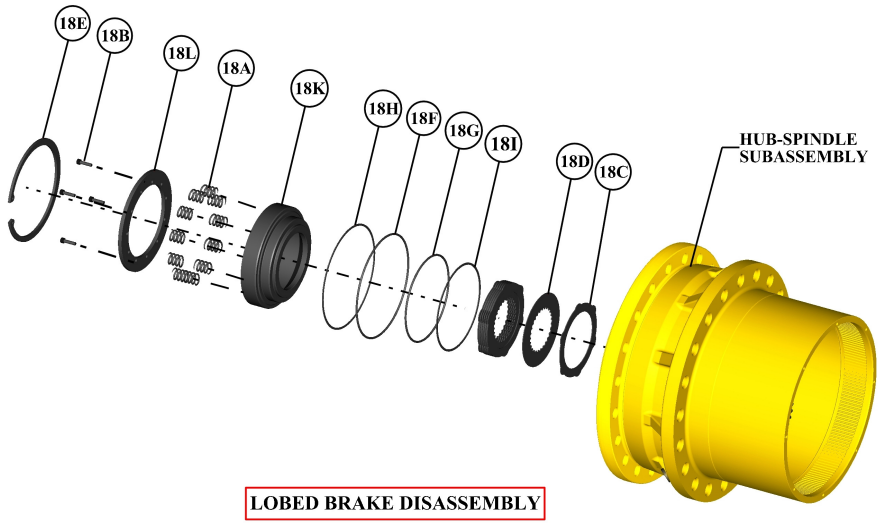
5. Remove Thrust Spacer (21D) from long shank end of Coupling (21A), if required.

6. Remove the other internal Retaining Ring (21C) further away from the long shank end of Coupling (21A).

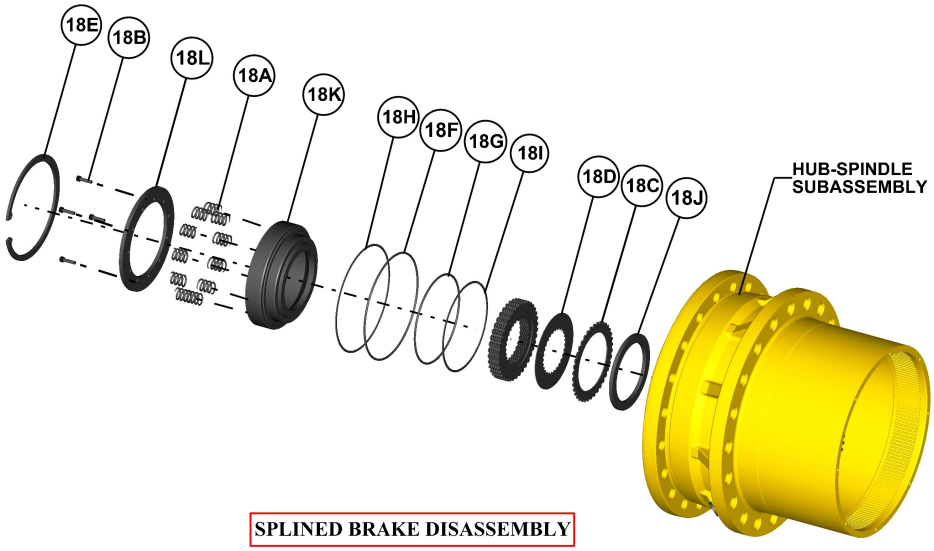
   NOTE: For Disengage, If the Coupling sub assembly consist of three retaining rings (As shown) then remove the internal Retaining Ring (21C/21F) from the end opposite to long shank of Coupling (21A).

This concludes the Input Disconnect Coupling Disassembly.

Planetary Final Drive Service Manual
Input Brake Disassembly



LOBED BRAKE DISASSEMBLY



SPLINED BRAKE DISASSEMBLY

Continued on Next Page

1. Place the Hub-Spindle assembly with the large opening facing upward.

2. Insert and tighten the M5 x 20 Socket Head Cap Screws (18B) into the Brake Piston (18K) to compress the springs and relieve pressure on the Retaining Ring (18E).

   CAUTION: Safety glasses must be worn during this next step.

   NOTE: Insure Step 2 is completed before doing this next step.

3. Using retaining ring pliers, remove Retaining Ring (18E) which holds the Brake Piston Subassembly (18) in place.

4. Lift Brake Piston Assembly (18) out of the Spindle (1A). If the Brake Piston Subassembly (18) will not lift out, use a dead blow hammer to lightly tap the Brake Piston (18K) out of the Spindle (1A). Remove Input Coupling Subassembly when the Brake Piston Subassembly (18) is removed. Remove the Inner (Rotor) (18D), Outer (Stator) Plates (18C), (End Plate (18J) only for Splined Brake) from inside the Spindle (1A).

5. Remove O-Rings (18F, 18G) and Backup Rings (18H, 18I) from the Spindle (1A). Discard O-Rings and Backup Rings.

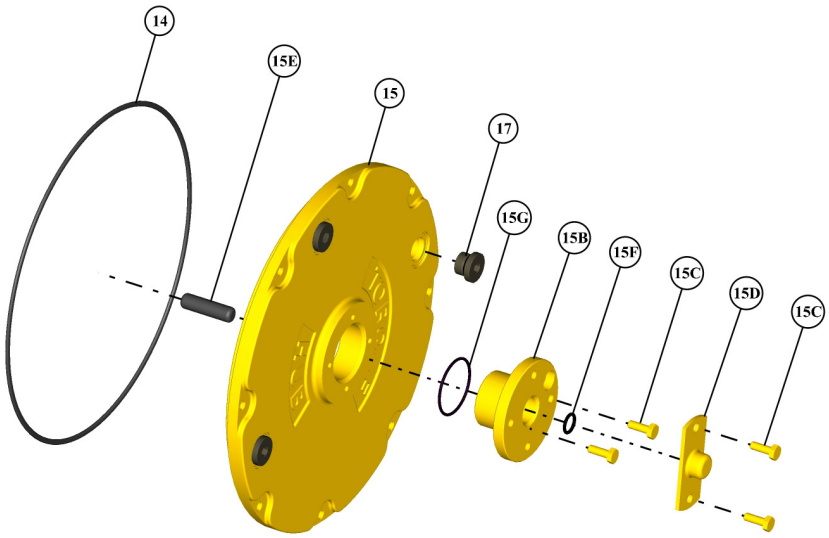
   NOTE: As an alternative to Step 4, the spindle port may be pressurized with air to push the brake piston out of the spindle.

6. Remove M5 x 20 Socket Head Cap Screws (18B) and lift the Thrust Plate (18L) from the Brake Piston (18K).

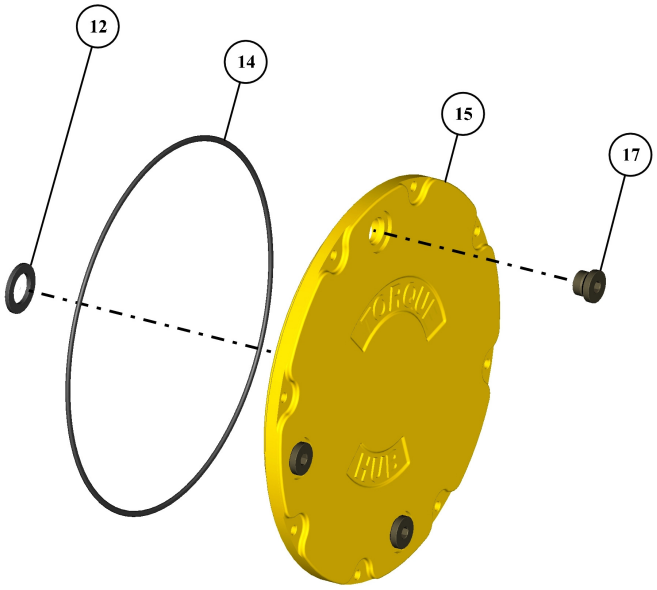
   NOTE: Record the number of springs and mark their locations before removing them from brake piston.

7. Remove Springs (18A) from the Brake Piston (18K).

This concludes the Input Brake Disassembly.



DISENGAGE COVER DISASSEMBLY



NON-DISENGAGE COVER DISASSEMBLY

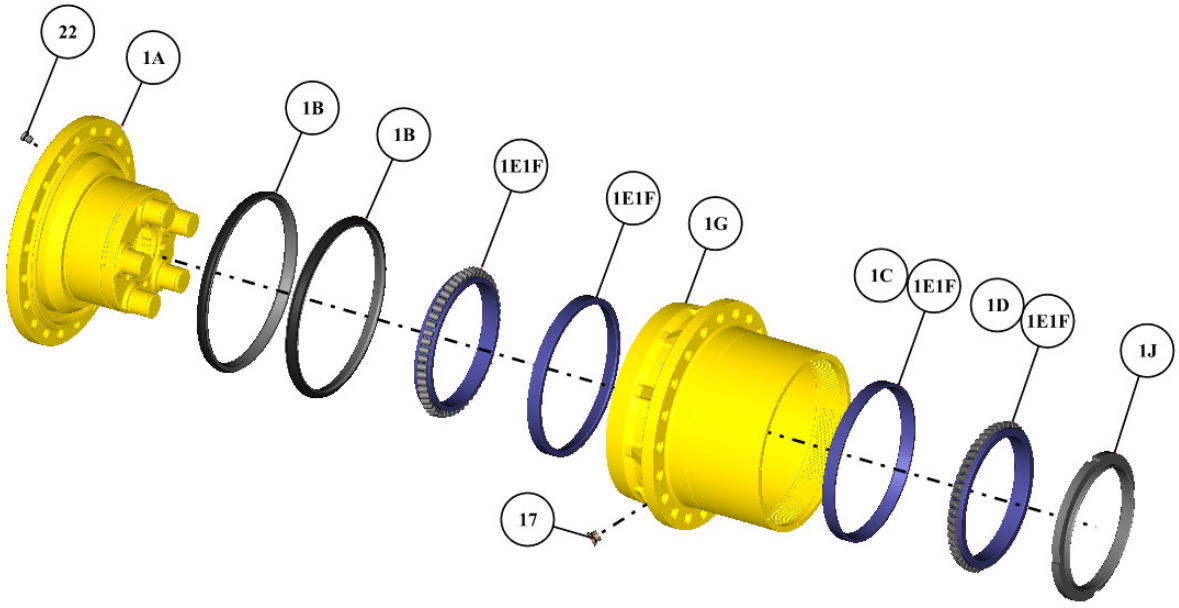
Continued on Next Page.

1. Remove the O-Ring (14) from groove in Cover (15) and Discard O-Ring.

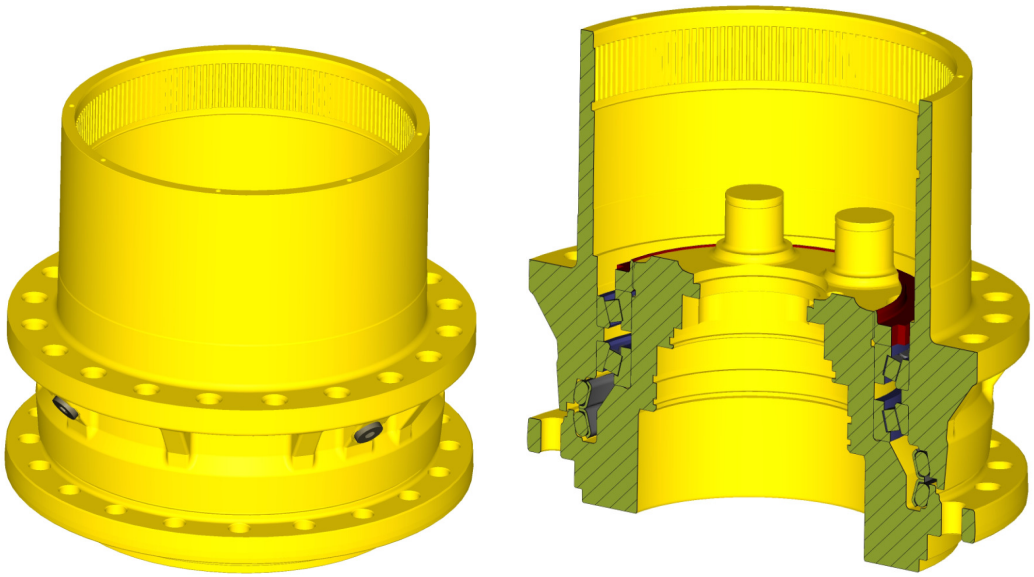
   NOTE: Skip step 2 for Disengage Cover Disassembly.

2. Remove Thrust Washer (12) from cover (15).
3. Remove Bolts (15C) from Disengage Cap (15D), if required.
4. Remove Bolts (15C) from Cover Cap (15B), if required.
5. Remove O-Ring's (15G & 15F) and discard.
6. Remove the Disengage Rod (15E) from Cover Cap (15B).

This concludes the Cover Disassembly.

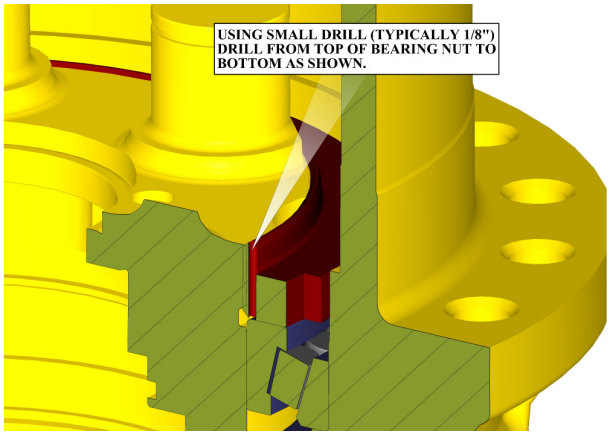


1. Set the unit on a bench so that the Spindle (1A) flange is down.

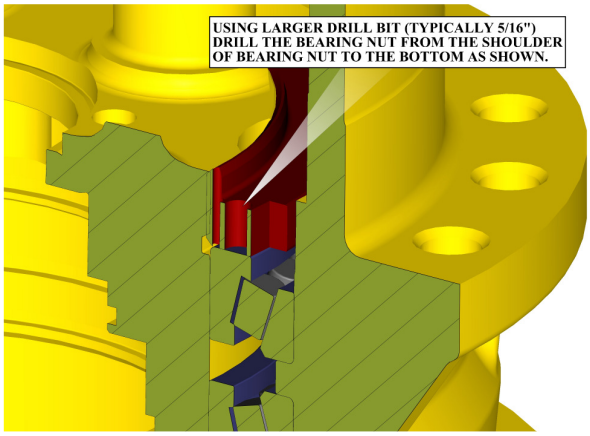


Continued on Next Page

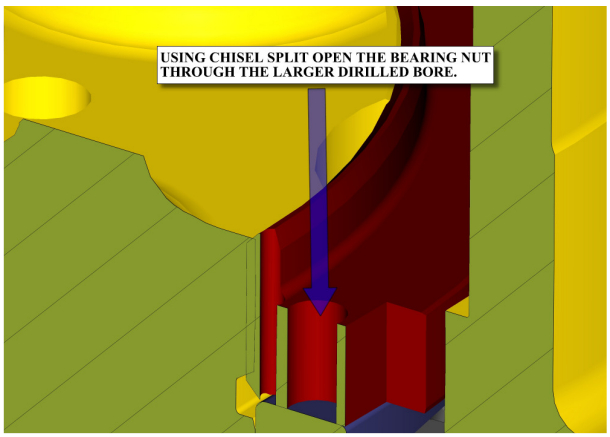
2. Using small drill bit (typically 1/8”), drill from top of bearing nut to bottom as shown below.



3. Using larger drill bit (typically 5/16”), drill the bearing but from the shoulder to the bottom as shown below.



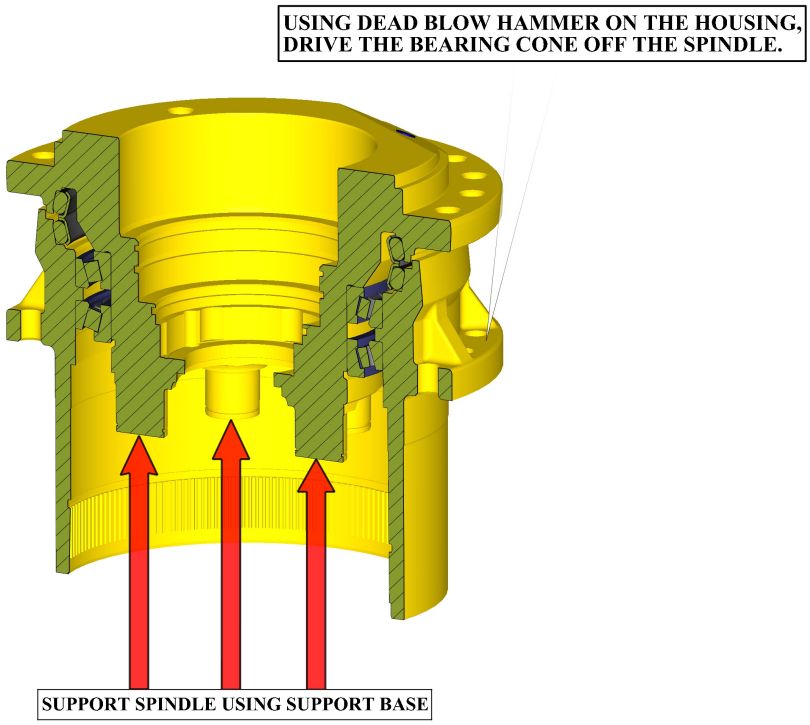
4. Using chisel through the larger drilled bore split open the bearing nut as shown below.



Continued on Next Page

5. Discard Locknut (1J), a new locknut must be used for reassembly.

6. Turn the unit over and carefully place the unit on a support base until the Spindle (1A) posts rests on it. Ensure there is enough gap to lower the Housing (1G) down.



7. Use a dead blow hammer on the Housing (1G) flange to drive the inboard Bearing Cone (1D/1E1F) off of the Spindle.

8. Lift the Spindle (1A) out of the Housing (1G).

9. Remove the Face Seal (1B) halves from the Housing (1G) and from the Spindle (1A).

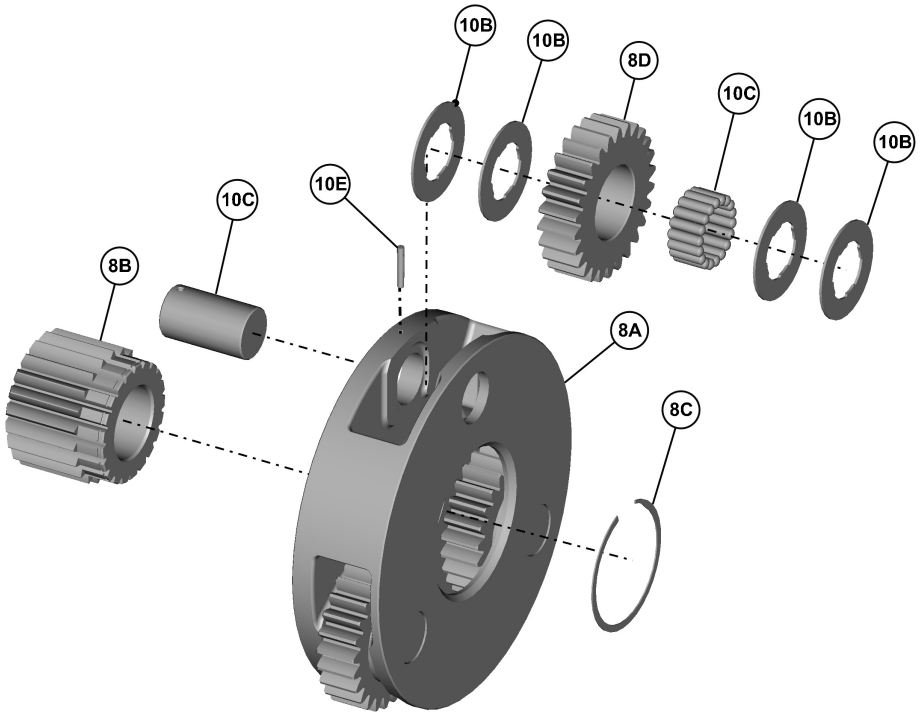
10. Using a hammer and punch drive the inboard Bearing Cup (1C/1E1F) out of the Housing (1G). Be careful not to damage the counter bore in the housing.

11. Turn the Housing (1G) over and drive the outboard Bearing Cup (1E1F) out of the Housing. Be careful not to damage the counter-bore in the housing.

12. Remove the Bearing Cone (1E1F) from the Spindle (1A).

This concludes the Housing-Spindle Disassembly.

Planetary Final Drive Service Manual
Intermediate Carrier Disassembly



1. Drive Planet Shaft (10D) out of the carrier pin holes; forcing the Roll Pin (10E) to sheer off.

2. Hold on to the Planet Gear (8D) and push the Planet Shaft (10D) out of the Carrier (8A).The Thrust Washers (10B) will slide off the Shaft as it is removed.

3. Using a hammer and punch drive the Roll Pin (10E) out of the Planet Shaft (10D) and Carrier (8A).

4. Remove Needle Bearings (10C) from the inside of the Planet Gear (8D).

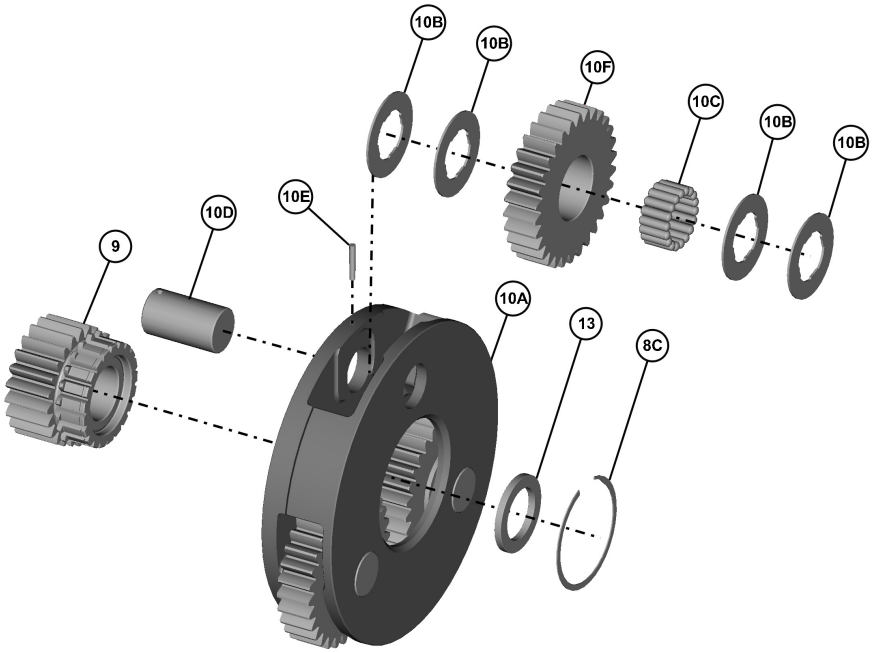
5. Repeat steps 1-4 for the remaining two Planet Gears (8D).

   CAUTION: Safety glasses must be worn during this next step.

6. Remove the Retaining Ring (8C) from the output Sun Gear (8B).

This concludes the Intermediate Carrier Disassembly.

Planetary Final Drive Service Manual
Input Carrier Disassembly



1. Drive Planet Shaft (10D) out of the carrier pin holes; forcing the Roll Pin (10E) to sheer off.

2. Hold on to the Planet Gear (10F) and push the Planet Shaft (10D) out of the Carrier (10A). The Thrust Washers (10B) will slide off the shaft as it is removed.

3. Using a hammer and punch drive the Roll Pin (10E) out of the Planet Shaft (10D) and Carrier (10A).

4. Remove Needle Bearings (10C) from the inside of the Planet Gear (10F).

5. Repeat steps 1-4 for the remaining two Planet Gears (10F).

   CAUTION: Safety glasses must be worn during this next step.

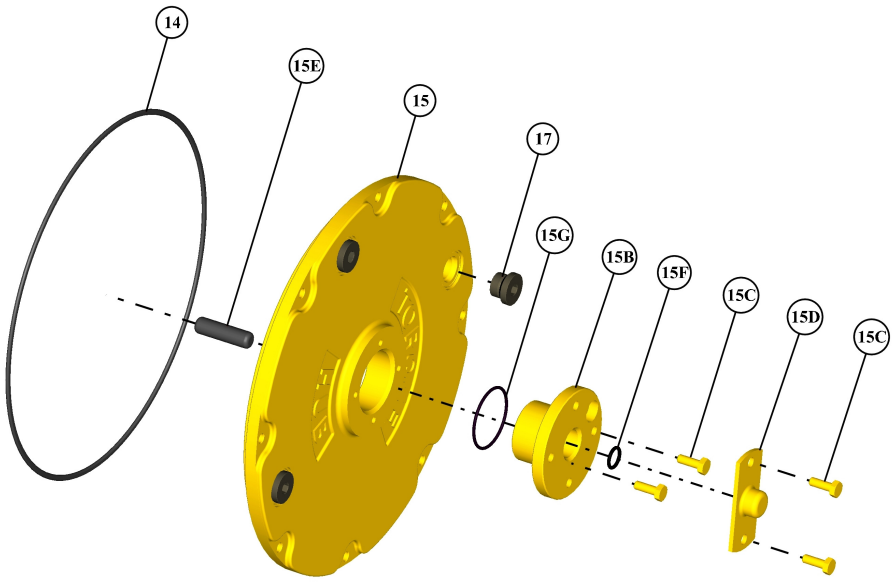
6. Remove the Retaining Ring (8C) from the Intermediate Sun Gear (9).

   NOTE: Skip below step for the Unit with ratio 202:1.

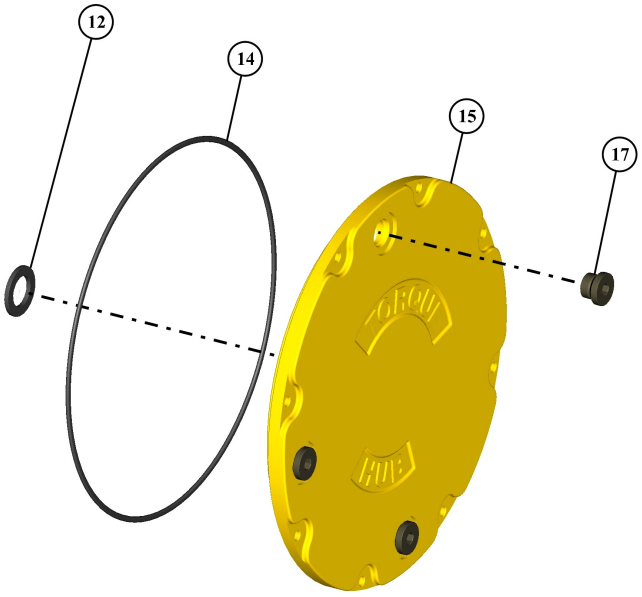
7. Remove Thrust Washer (13) from bore of Intermediate Sun Gear (9).

This concludes the Input Carrier Disassembly.

ASSEMBLY



DISENGAGE COVER SUBASSEMBLY



NON-DISENGAGE COVER SUBASSEMBLY

Continued on Next Page.

1. Install Pipe Plugs (17) into Cover (15).

   NOTE: Skip step 2 for Disengage Cover Subassembly.

2. Place the Thrust Washer (12) into counter bore of Cover (15) using grease to hold it in place.

3. Using alcohol and a clean rag, wipe out O-Ring groove in the Cover (15). Grease O-Ring (14) and install into O-Ring groove in Cover (15).

4. Place greased O-Ring (15F) internal groove of Cover Cap (15B).

   NOTE: The Disengage Rod (15E) may be used to push O-Ring (15F) into position in the O-Ring groove of the Cover Cap (15B).

5. Grease O-Ring (15G) and position over Cover Cap (15B) until it rests against the flange.

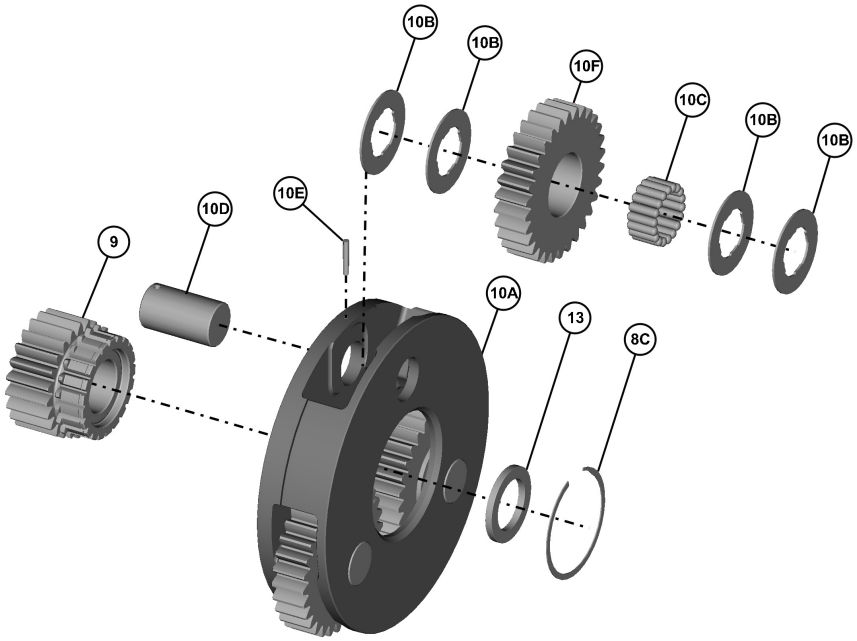
6. Install Cover Cap (15B) into Cover (15) and fasten with two Bolts (15C) located 180 degrees apart. Torque Bolts to 70-80 in-lbs.

   NOTE: There is no timing required between Cover (15) and larger flange hole in Cover Cap (15B).

7. Place Disengage Cap (15D) on Cover Cap (15B) with the nipple facing out. Secure with two Bolts (15C) located 180 degrees apart. Torque Bolts to 70-80 in-lbs.

8. Turn Cover (15) over and push Disengage Rod (15E) into Cover Cap (15B) until Disengage Rod (15E) bottoms out on Disengage Cap (15D).

This concludes the Cover Subassembly.



1. Apply a liberal coat of grease to the bore of the Planet Gear (10F). This will enable the Needle Rollers (10C) to be held in place during assembly.

2. Install Needle Rollers (10C) into the bore of each of the three Planet Gears (10F).

   NOTE: The last roller installed must be installed end wise. That is, the end of the last roller must be placed in between the ends of the two rollers that form the space, and then slide parallel to the other rollers into place.

3. Place Sun Gear (9) on bench with spline ends up.

4. Install Carrier (10A) onto splines of Sun Gear (9).

   CAUTION: Safety glasses must be worn during these next steps.

5. Install Retaining Ring (8C) into groove on spline end of Sun Gear (9) retaining the sun gear in the carrier.

6. Place Carrier (10A) into tool fixture so that one of the roll pin holes is straight up.

Continued on Next Page

7. Start Planet Shaft (10D), with end opposite roll pin hole first, through the planet shaft hole in Carrier (10A), making sure that the roll pin hole with the large chamfer in the planet shaft is straight up.

8. Using ample grease to hold them in position, slide two Thrust Washers (10B) onto Planet Shaft (10D).

9. Place Planet Gear (10F) into position and push Planet Shaft (10D) through planet gear without going all the way through carrier.

10. Using ample grease to hold them in position, slide two Thrust Washers (10B) between Planet Gear (10F) and Carrier (10A).

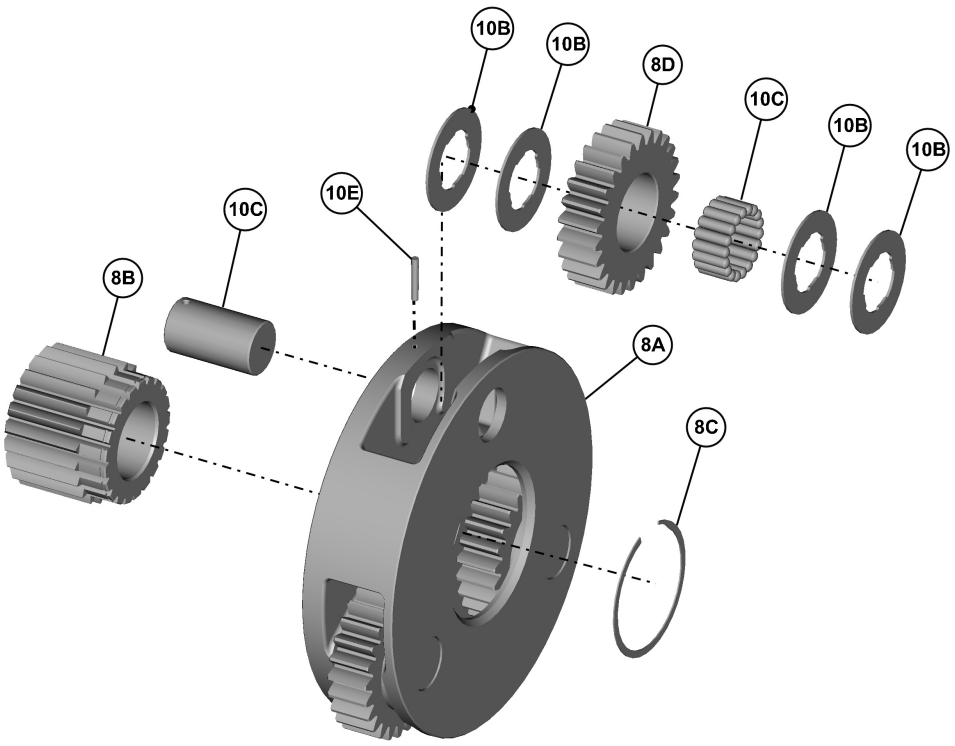
11. Finish pushing Planet Shaft (10D) into Carrier (10A) until roll pin holes of planet shaft and carrier are aligned. Align roll pin holes using a 1/8-inch diameter punch.

12. Drive the Roll Pin (10E) into the roll pin hole in carrier and into the Planet Shaft (10D) until other end of the roll pin is flush with the outside of Carrier (10A).

13. Repeat steps 6 through 12 for the remaining two Planet Gears (10F).

This concludes the Input Carrier Subassembly.

Intermediate Carrier Subassembly



1. Apply a liberal coat of grease to the bore of the Planet Gear (8D). This will enable the Needle Rollers (10C) to be held in place during assembly.

2. Install Needle Rollers (10C) into the bore of each of the three Planet Gears (10F).

   NOTE: The last roller installed must be installed end wise. That is, the end of the last roller must be placed in between the ends of the two rollers that form the space, and then slide parallel to the other rollers into place.

3. Place Sun Gear (8B) on bench with spline ends up.

4. Install Carrier onto splines of Sun Gear (8B).

   CAUTION: Safety glasses must be worn during these next steps.

5. Install Retaining Ring (8C) into groove on spline end of Sun Gear (8B) retaining the sun gear in the carrier.

6. Place Carrier into tool fixture so that one of the roll pin holes is straight up.

7. Start Planet Shaft (10D), with end opposite roll pin hole first, through the planet shaft hole in carrier (8A), making sure that the roll pin hole with the large chamfer in the planet shaft is straight up.

Continued on Next Page

8. Using ample grease to hold them in position, slide two Thrust Washers (10B) onto Planet Shaft (10D).

9. Place Planet Gear (8D) into position and push Planet Shaft (10D) through planet gear without going all the way through carrier.

10. Using ample grease to hold them in position, slide two Thrust Washers (10B) between Planet Gear (8D) and Carrier (8A).

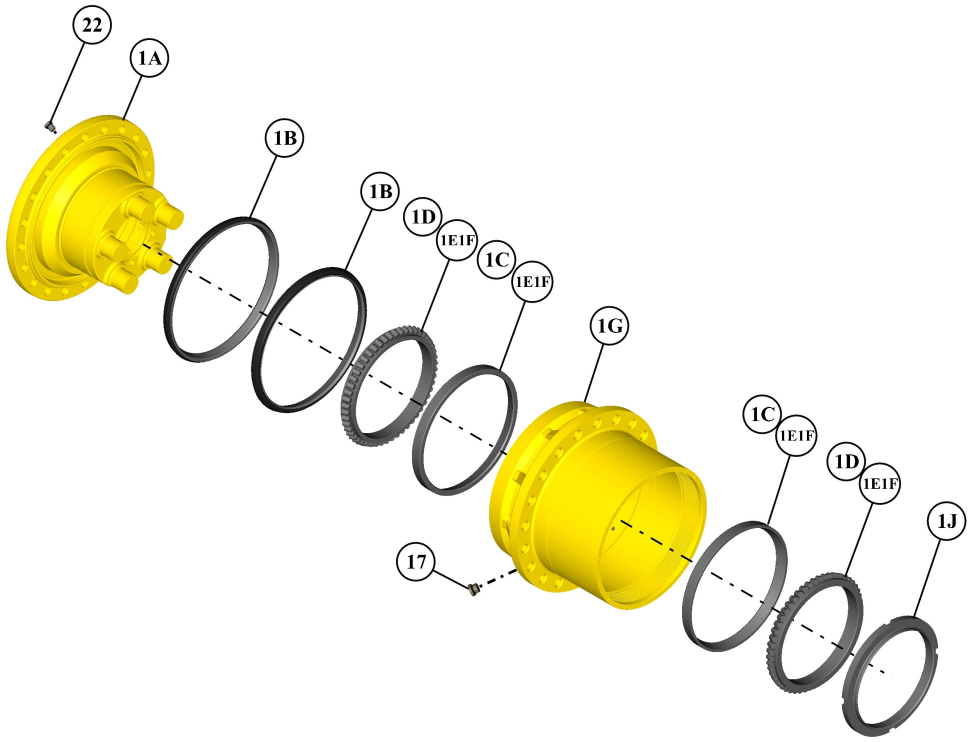
11. Finish pushing Planet Shaft (10D) into Carrier until roll pin holes of planet shaft and carrier are aligned. If necessary, align roll pin holes using a 1/8-inch diameter punch.

12. Drive the Roll Pin (10E) into the roll pin hole in carrier and into the Planet Shaft (10D) until other end of the roll pin is flush with the outside of Carrier (8A).

13. Repeat steps 6 through 12 for the remaining two Planet Gears (8D).

This concludes the Intermediate Carrier Subassembly.

Housing - Spindle Subassembly



1. Using alcohol and a clean rag, wipe off bearing locations on the Housing (1G) and the Spindle (1A).

2. Press one Bearing Cup (1E1F, 1C) using Tool T187055 into bearing counter bore of cover end of Housing (1G) making sure that it is fully seated against shoulder in the housing.

3. Turn Housing (1G) over and press one Bearing Cup (1E1F, 1C) using Tool T187055 into bearing counter bore of spindle end of housing until seated against shoulder in housing.

4. Install two Pipe Plugs (17) in Housing (1G).

5. Using alcohol and a clean rag, wipe off seal locations on the Housing (1G) and the Spindle (1A).

   NOTE: Refer pages 14 through 16 for detailed instructions on face seal installation.

6. Place Spindle (1A) onto bench, with planet posts facing up.

   NOTE: Generally seals should not be reused.

7. Using alcohol and a clean rag, thoroughly clean one half of the Face Seal (1B). Place outside diameter of metal ring of Face Seal (B) into groove of seal installation tool, and then collapse tool and tighten wing nut. Making sure that rubber ring of Face Seal is wet with alcohol; push Face seal into seal counter bore of Spindle (1A) by hand until it is seated. Face Seal (1B) is seated when end of seal installation tool contacts the end of the Spindle (1A).

Continued on Next Page

8. Place one Bearing Cone (1E1F, 1D) onto Spindle (1A), and spray with a light coat of oil.

9. Using alcohol and a clean rag thoroughly clean the other half of the Face Seal (1B). Place outside diameter of metal ring of Face Seal (1B) into groove of seal installation tool, T-189079, and then collapse tool and tighten wing nut. Making sure that rubber ring of Face Seal (1B) is wet with alcohol, push Face seal (1B) into seal counter bore of the Housing (1G) by hand until it is seated. Face Seal (1B) is seated when end of seal installation tool contacts the end of the Housing (1G).

10. Using alcohol and a clean rag, thoroughly clean the metal faces of both halves of the Face Seal (1B) then coat with gear oil. Carefully place Housing (1G) onto Spindle (1A) so that two halves of Face Seal (1B) contact each other. Do not allow Face Seal (1B) to contact bench or get damaged when flipping Housing (1G) over.

11. Place other Bearing Cone (1E1F, 1D) onto Spindle (1A) until it is seated in Bearing Cup (1E1F, 1C) in Housing (1G) and spray with a light coat of oil.

    NOTE: Insure Bearing Nut (1J) spins free on Spindle (1A) threads.

12. Install Bearing Nut (1J) onto Spindle (1A) and tighten using locknut wrench Tool T187057. Torque Bearing Nut (1J) to 350 ft-lbs, rotate Housing (1G) in both directions, and then torque Bearing Nut to 350 ft-lbs. Rotate Housing (1G) in both directions again and torque bearing nut to 350 ft-lbs. Repeat this until Bearing Nut (1J) does not move when 350 ft-lbs of torque is applied.

LEAK CHECK THE FACE SEAL ASSEMBLY

13. Install Cover (15) subassembly using four Bolts (16).

14. Turn unit over onto its side and plug brake port in Spindle (1A) with Pipe Plug (17) or if unit is to have brakes installed, then plug brake port with an M12 x 1.5 O-Ring Pipe Plug.

15. Perform LEAK TEST as per instructions on page 10.

16. IF UNIT DOES NOT LEAK, remove Pipe Plug (17) in brake port if unit is to have brakes installed. If no brake is to be installed in unit, do not remove Pipe Plug (17).

17. Turn unit over onto Spindle (1A) end and remove Cover (15) subassembly.

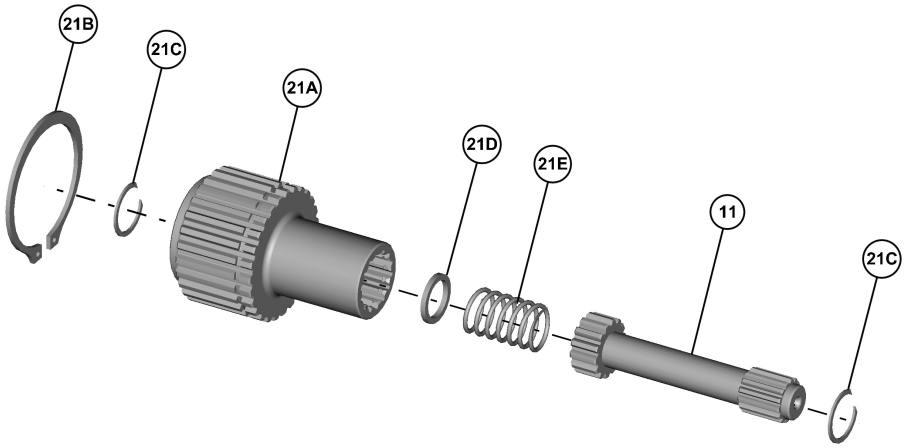
18. Remove Bearing Nut (1J). Clean threads of spindle and bearing nut with alcohol.

19. Apply Loctite 263 to threads of Bearing Nut (1J) And Install onto Spindle (1A) and tighten using locknut wrench. Torque Bearing Nut (1J) to 350 ft-lbs, rotate Housing (1G) in both directions, and then torque Bearing Nut to 350 ft-lbs. Rotate Housing (1G) in both directions again and torque bearing nut to 350 ft-lbs. Repeat this until Bearing Nut (1J) does not move when 350 ft-lbs of torque is applied.

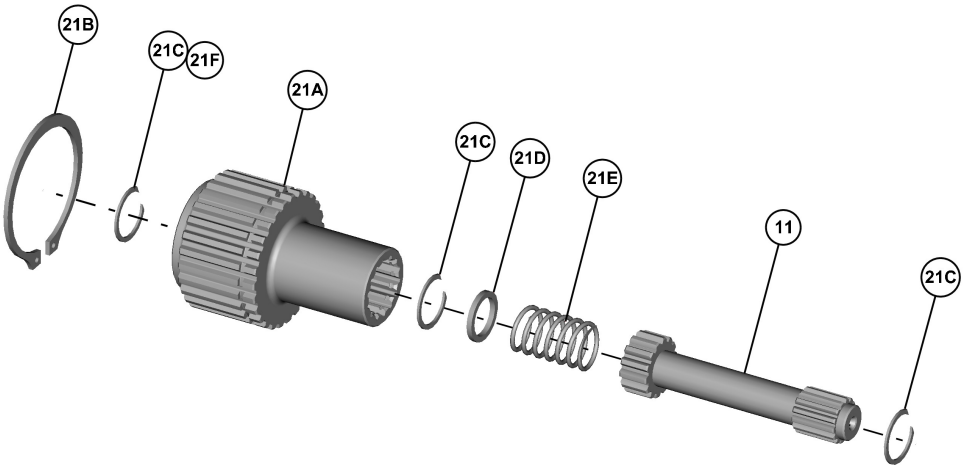
20. Stake Bearing Nut (1J) in two places using staking tool, T-189262. Place sliding block of staking tool against inside diameter of Hosing (1G) at staking cutouts on Spindle (1A). Hit end of staking tool with hammer until rim of Bearing Nut (1J) swells into cutouts in Spindle (1A).

This concludes the Housing-Spindle Subassembly.

Input Disconnect Coupling Subassembly



DISENGAGE - COUPLING WITH TWO INTERNAL RETAINING RINGS



DISENGAGE - COUPLING WITH THREE INTERNAL RETAINING RINGS

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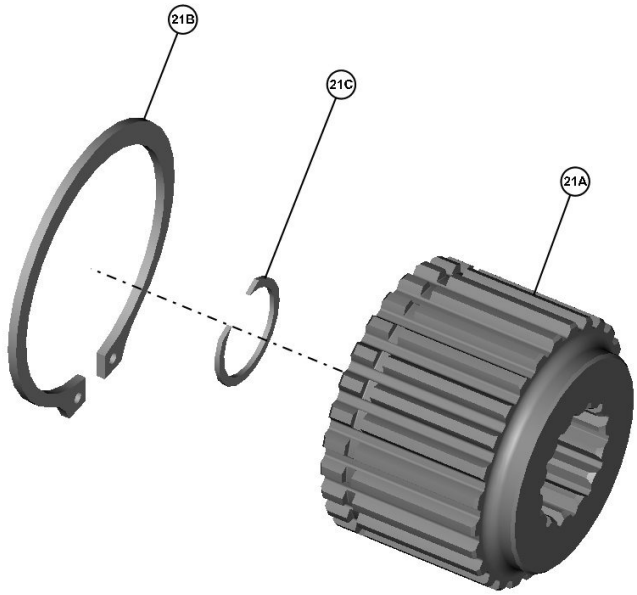


NON DISENGAGE - COUPLING WITH ONE INTERNAL RETAINING RING

CAUTION: Safety glasses must be worn during these next steps.

1. Using retaining ring pliers, install external Retaining Ring (21B) into groove on OD of Coupling (21A), if required.

2. Install Internal Retaining Ring (21C/21F) using retaining ring pliers into retaining ring groove of the Coupling (21).

   NOTE: Skip below steps for Non Disengage Coupling assembly.

3. Using retaining ring pliers, install internal Retaining Ring (21C) into the retaining ring groove second close to the end of long shank in Coupling (21A).

4. Place Thrust Spacer (21D) into long shank end of Coupling (21A) against Retaining Ring (21C) installed second close to the end of long shank in Coupling (21A).

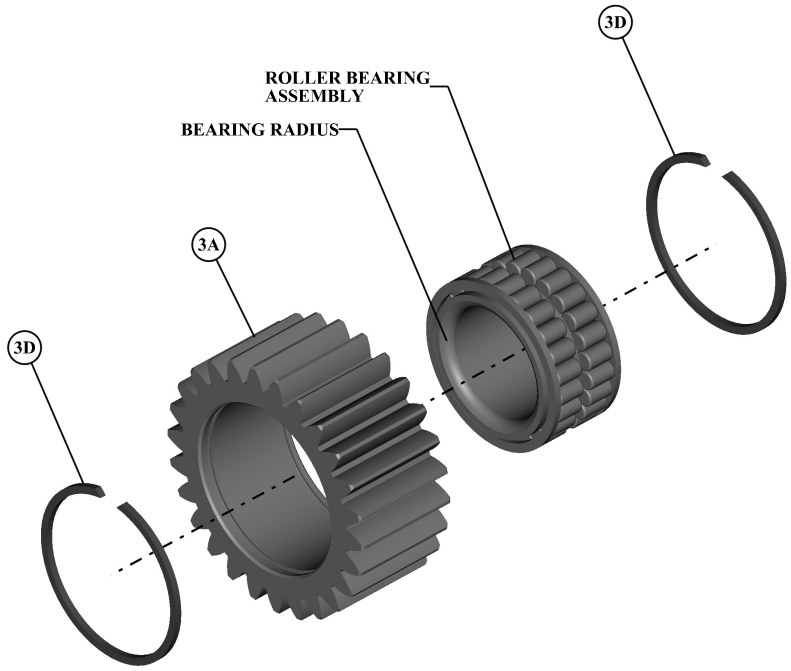
5. Install Spring (21E) into long shank end of Coupling (21A) against Thrust Spacer (21D).

6. Slide internal Retaining Ring (21C) over small diameter spline of Input Shaft (11).

7. Push large diameter spline end of Input Shaft (11) into Coupling (21A) and compress Spring (21E) until internal retaining ring groove in long shank end of Coupling (21A) is visible. Using retaining ring pliers, push Retaining Ring (21C) into retaining ring groove in long shank end of Coupling (21A).

This concludes the Input Disconnect Coupling Subassembly.

Output Planet Gear Subassembly



1. Check Planet Gear Sets (3A) to make sure that all of the gears in each set have matching serial numbers etched on them, then place Planet Gears (3A) on bench with bearing lead in chamfer on bore facing up. Keep Planet Gear Sets (3A) separate.

   CAUTION: Safety glasses must be worn during these next steps.

2. Install Retaining Ring (3D) into the end of the Planet Gear (3A).

3. Drop in the Roller Bearing assembly with bearing radius down.

   NOTE: Insure Washer included with Bearing is also in place.

4. Install Retaining Ring (3D) into the groove of the Planet Gear (3A) to hold roller bearing assembly in place. Making sure Retaining Ring (3D) is fully seated in the groove.

5. Repeat steps 2 to 4 for remaining Planet Gears (3A). Keep assembled Planet Gears (3A) matched sets together.

This concludes the Output Planet Gear Subassembly.

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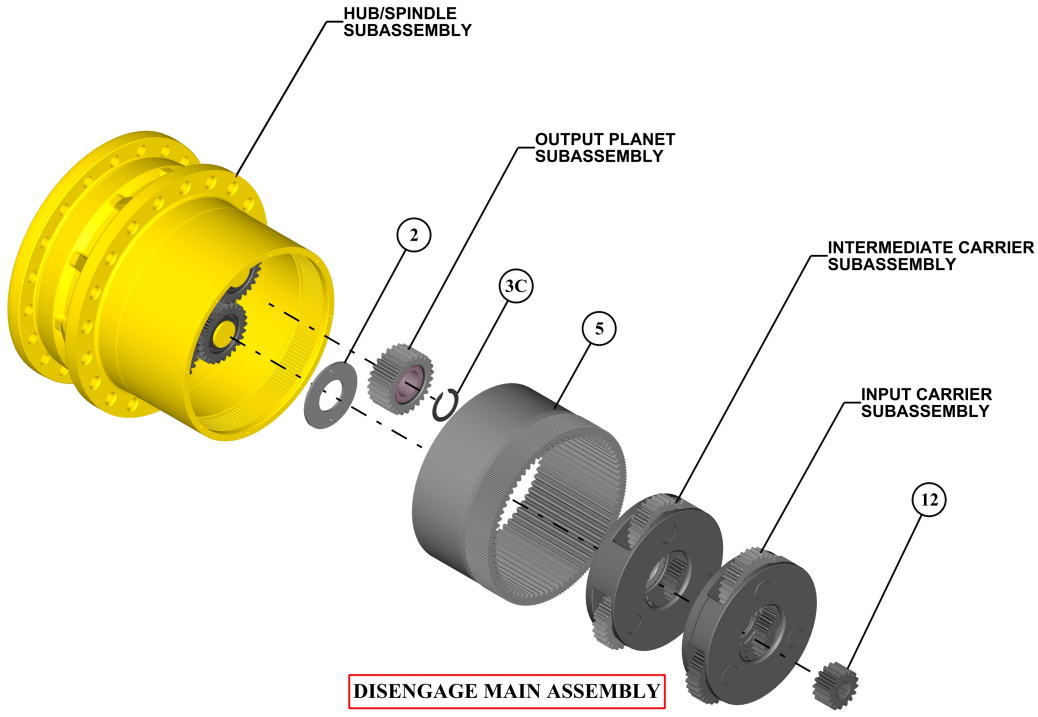
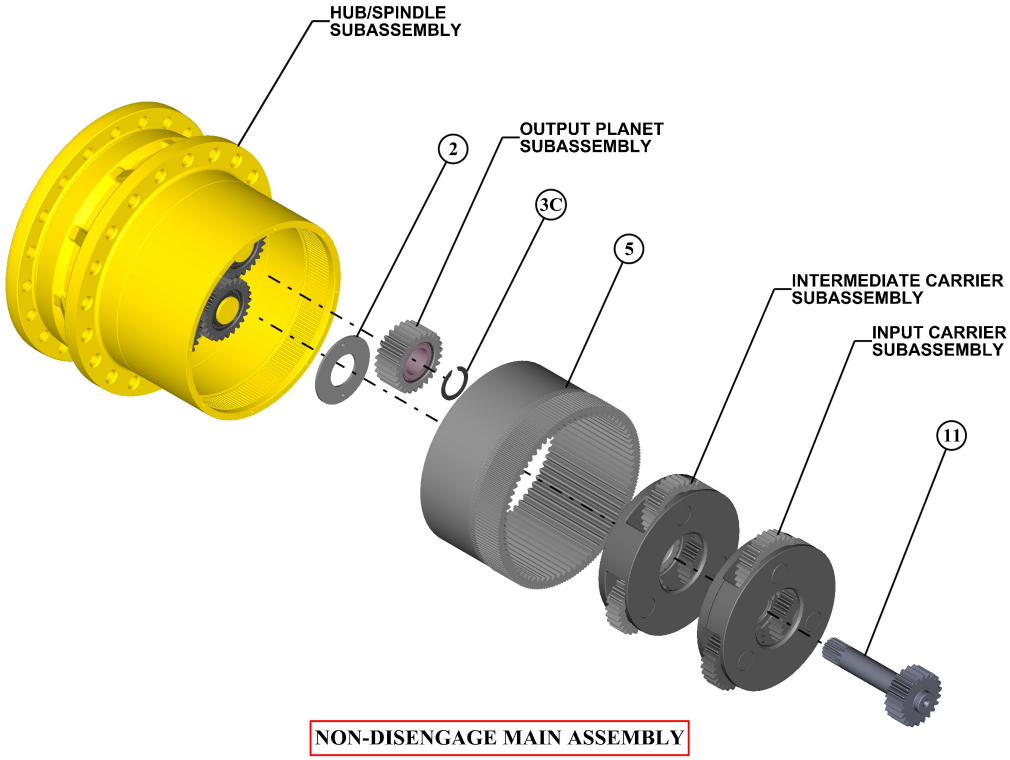
Planetary Final Drive Service Manual
Main Assembly



DISENGAGE MAIN ASSEMBLY



NON-DISENGAGE MAIN ASSEMBLY

Continued on Next Page

1. Place Hub-Spindle Sub assembly onto the table with Spindle flange side down.

2. Preheat bearing heating oven to 250°F.

3. Install Thrust Spacer (2) into counter bore of Spindle (1A).

4. Once oven has reached 250°F, place Planet Gear Sets (3A) into oven and leave in for 15 to 20 minutes. Do not leave gears in oven for more than 20 minutes, as metallurgical damage can occur if gears reach 250°F. Damage can occur before gears discolor.

5. Remove Planet Gears (3A) from oven and immediately push one Planet Gear (3A), starting with large radius on bore of Cylindrical Roller Bearing (3B), onto each planet post of Spindle (1A) until bearing hits shoulder of planet post on Spindle (1A). If Planet Gear gets stuck on post before bearing hits shoulder of planet post, immediately press bearing the rest of the way on using T-174699 pressing tool. Keep Planet Gears Sets (3A) together during assembly. One set per each Spindle (1A).

   NOTE: Do not beat planet gears onto spindle posts with bar stock or hammer.

   CAUTION: Safety glasses must be worn during these next steps.

6. Install Retaining Ring (3C) on each planet post of Spindle (1A).

7. Place Ring Gear (5) into Housing Spindle Subassembly with spline end of Ring Gear (5) towards Cover (15) ends of Housing (1G).

8. Install Intermediate Carrier Subassembly into Ring Gear (5) with Output Sun Gear (8B) facing down.

9. Install Input Carrier Subassembly into Ring Gear (5) with Intermediate Sun Gear (9) facing down.

   NOTE: On units with a ratio of greater than 36:1, there will be no Input Sun Gear (12). The teeth will be integrated on the Input Shaft.

10. If applicable, install Sun Gear (12) into input carrier planet gear mesh.

    NOTE: Skip step below for Disengage main assembly.

11. Install Input Shaft (11) into input carrier planet gear mesh.

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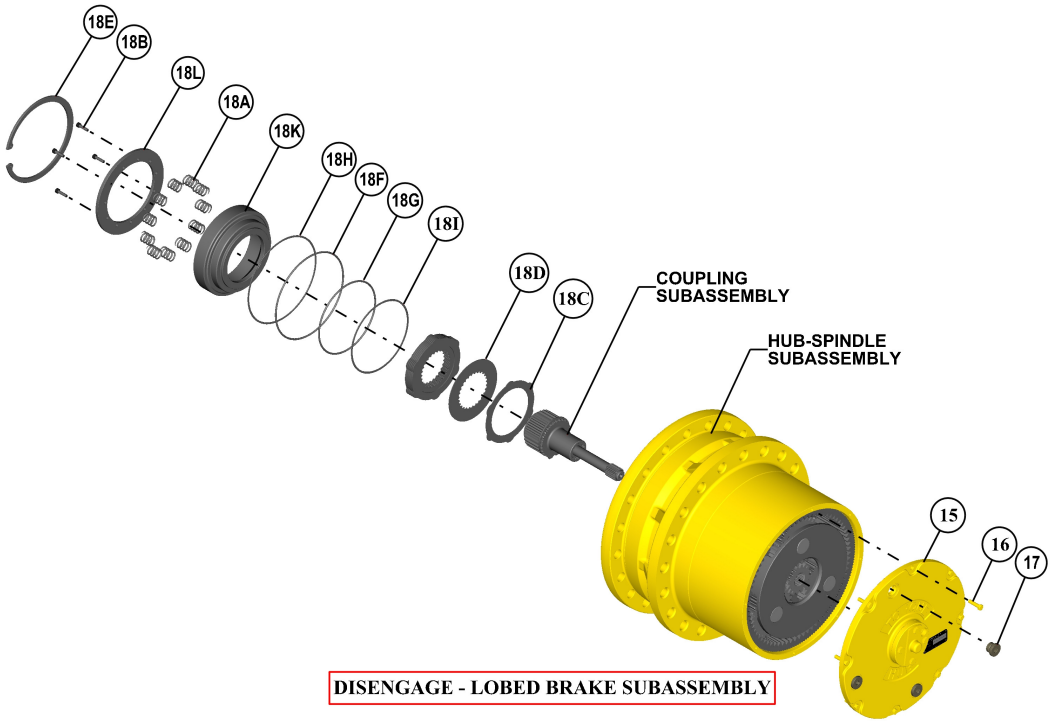
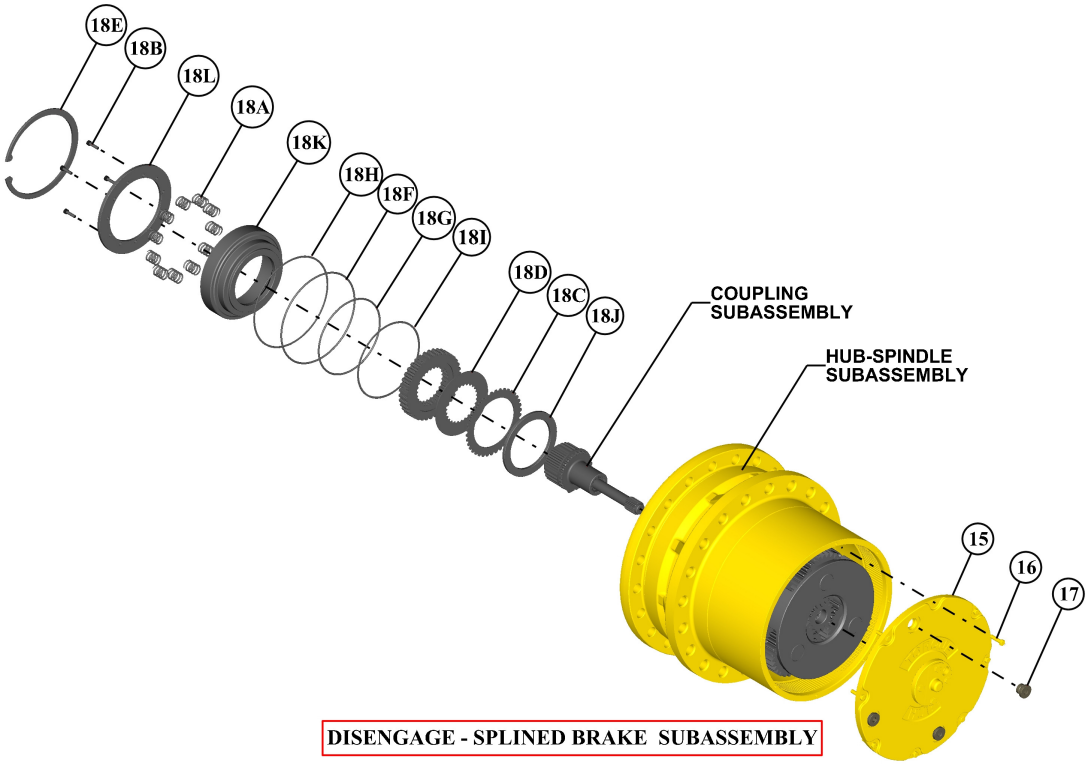
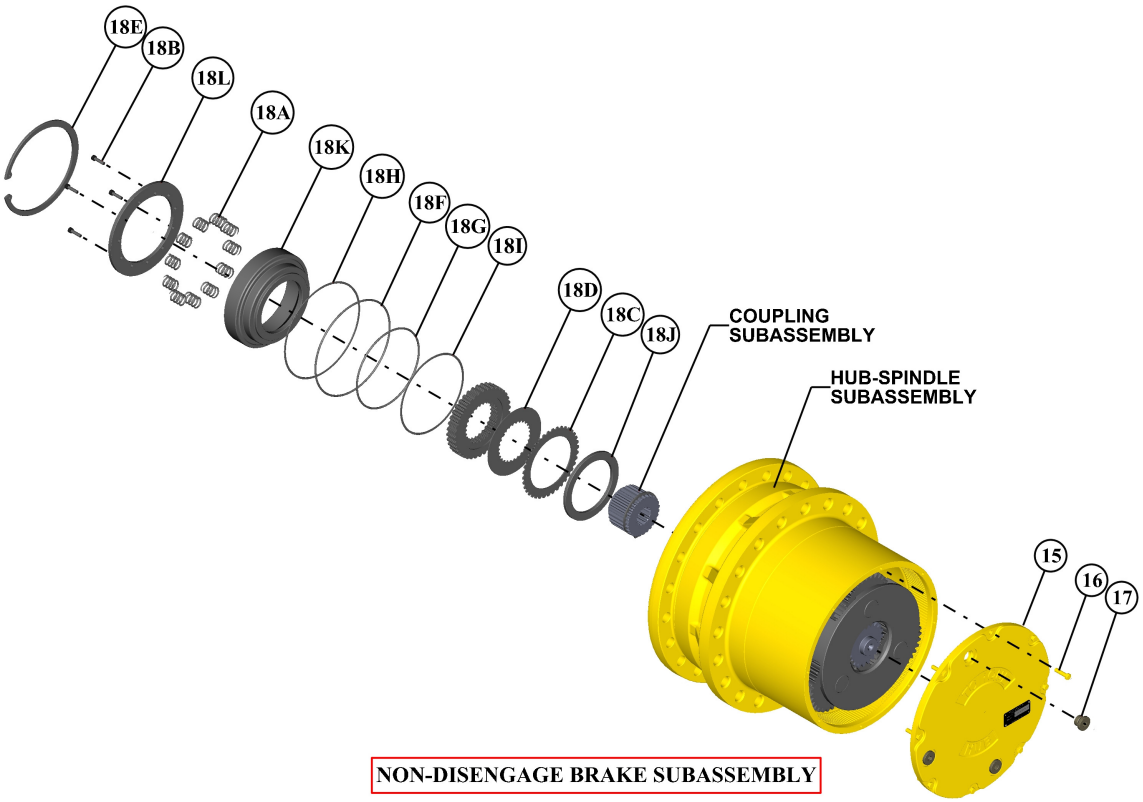


DISENGAGE - LOBED BRAKE SUBASSEMBLY



DISENGAGE - SPLINED BRAKE SUBASSEMBLY

Continued on Next Page



12. Align pipe plugs (17) to proper location per print and install Cover Subassembly (15) to Housing (1G) using eight Bolts (16). Torque bolts to 105-110 in-lbs.

13. Insert the Input Coupling Subassembly (21A) into Hub-Spindle Subassembly.

14. Insert Brake Piston (18K) completely into Hub-Spindle without O-Rings (18H, 18G) and Backup Rings (18F, 18I) to check fit of brake. The Brake Piston (1K) should slide into Hub-Spindle without being forced. If Brake Piston (1K) does not fit, check for burrs or size problems before proceeding.

15. Grease O-Rings (18H, 18G) and install smaller diameter O-Ring (18G) into smaller diameter O-Ring groove in Hub-Spindle and install larger diameter O-Ring (18H) into larger diameter O-Ring groove in Hub-Spindle.

16. Uncoil smaller diameter Backup Ring (18I) and place one end in smaller diameter retaining ring groove in Hub-Spindle between O-Ring (18G) and side of groove towards planet posts on Hub-Spindle. Gradually feed Backup Ring (18I) into groove allowing it to wrap around groove two times.

17. Uncoil larger diameter Backup Ring (18F) and place one end in larger diameter retaining ring groove in Hub-Spindle between O-Ring (18H) and side of groove towards flange of Hub-Spindle. Gradually feed Backup Ring into groove allowing it to wrap around groove until ends meet.

18. Starting with a Stator, alternately stack and install Stators into Lobes or Splines of Hub-Spindle and Rotors (internal splines) onto splines of Input Coupling (21A).

Continued on Next Page

NOTE: There should always be a stator on the top and bottom of the stack.

19. Lightly grease cylinder walls of Hub-Spindle and install Brake Piston (18K) into Hub-Spindle. If necessary, place T-134711 on top of brake and lightly tap until Brake Piston (18K) contacts brake disk stack.

20. Insert correct amount of Springs (18A) into Brake Piston (18K) spring holes. (Refer Brake Chart in Page 6).

21. Install Socket Head Cap Screws (18B) through the Thrust Plate (18L) into the Piston (18K). Tighten Socket Head Cap Screws (18B) incrementally to evenly compress the Springs (18A).

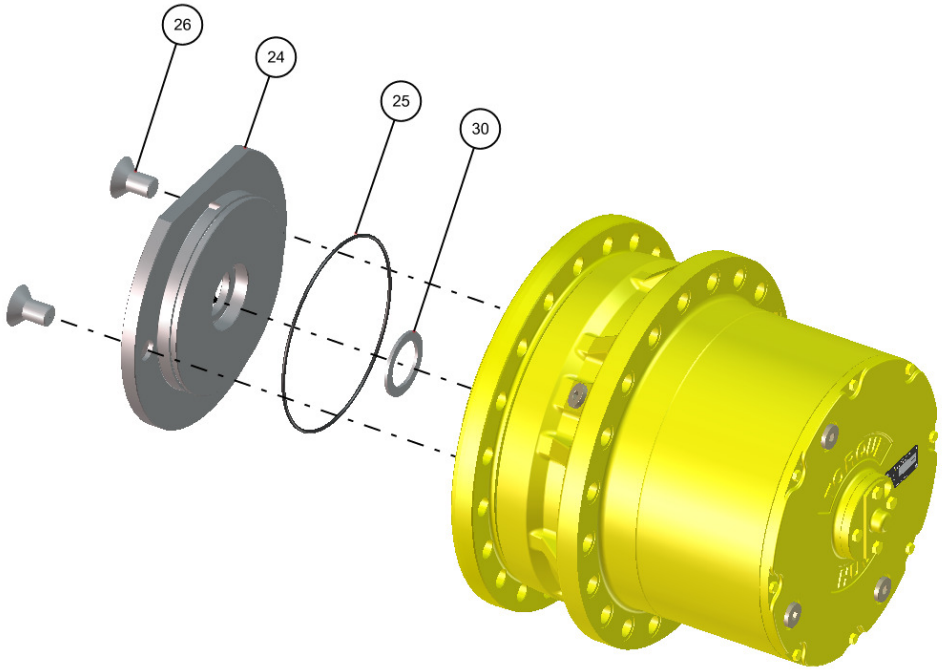
CAUTION: Safety glasses must be worn during these next steps.

22. Using retaining ring pliers, install large Retaining Ring (18E) into groove in Hub-Spindle making sure that it is seated properly.

NOTE: Use caution when installing retaining ring (18E) into Hub-spindle. It may cause injury if it slips out of retaining ring pliers.

23. The Unit should undergo brake test as per instructions on page 5, 6, 7 and 8.

NOTE: Skip steps 24,25 and 26 if unit does not have Adaptor Mounting (24).



24. Grease and Install Thrust Washer (30) into Adaptor Mount (24).

Continued on Next Page

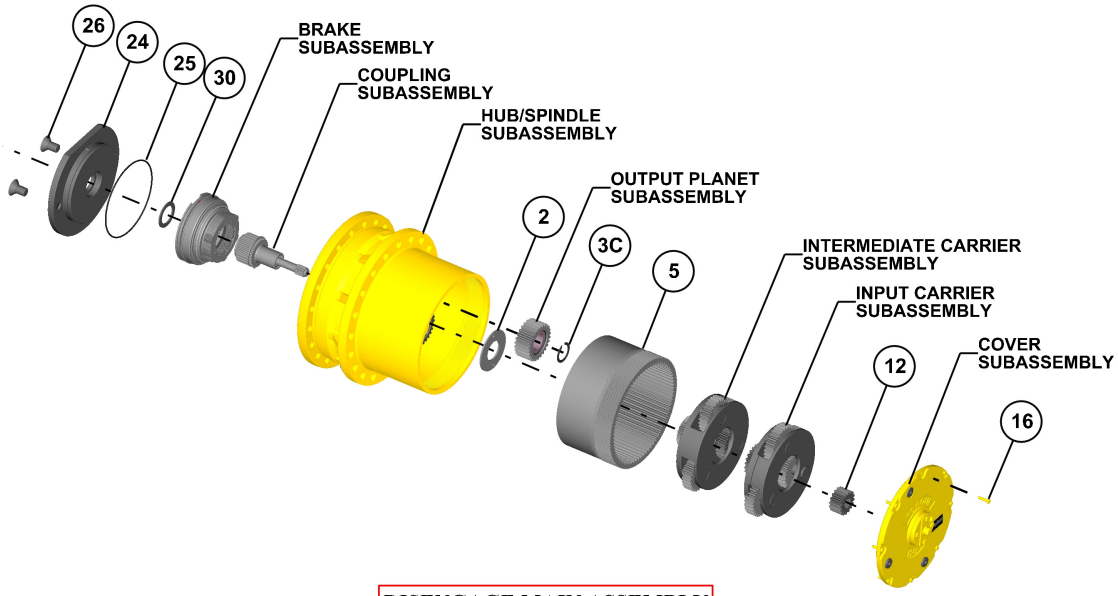
25. Grease and Install O-Ring (25) onto O-Ring groove of Adaptor Mount (24).

26. Install Adaptor Mount (24) onto Hub-Spindle using Bolts (26).

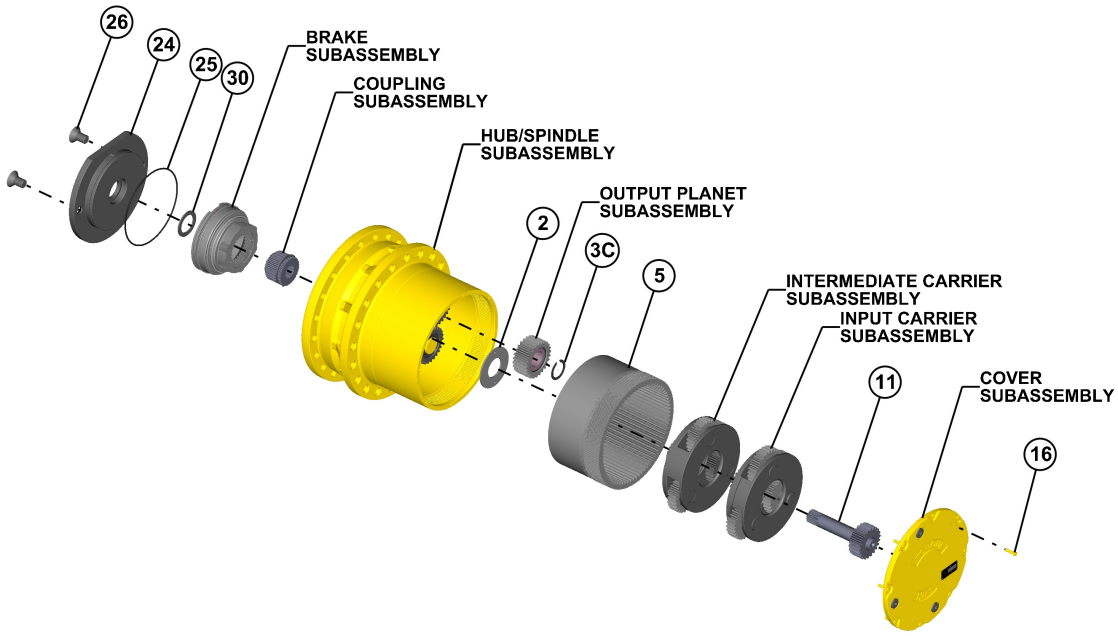
27. The unit should now be leak and roll checked as per instructions on page 9 and 10. The motor can be reinstalled into the gearbox for the leak check to seal it off, and the unit pressurized through a pipe plug hole on the cover.

This concludes the Main assembly.

Planetary Final Drive Service Manual
Assembly Drawing



DISENGAGE MAIN ASSEMBLY



NON - DISENGAGE MAIN ASSEMBLY

Planetary Final Drive Repair Instructions
Parts List

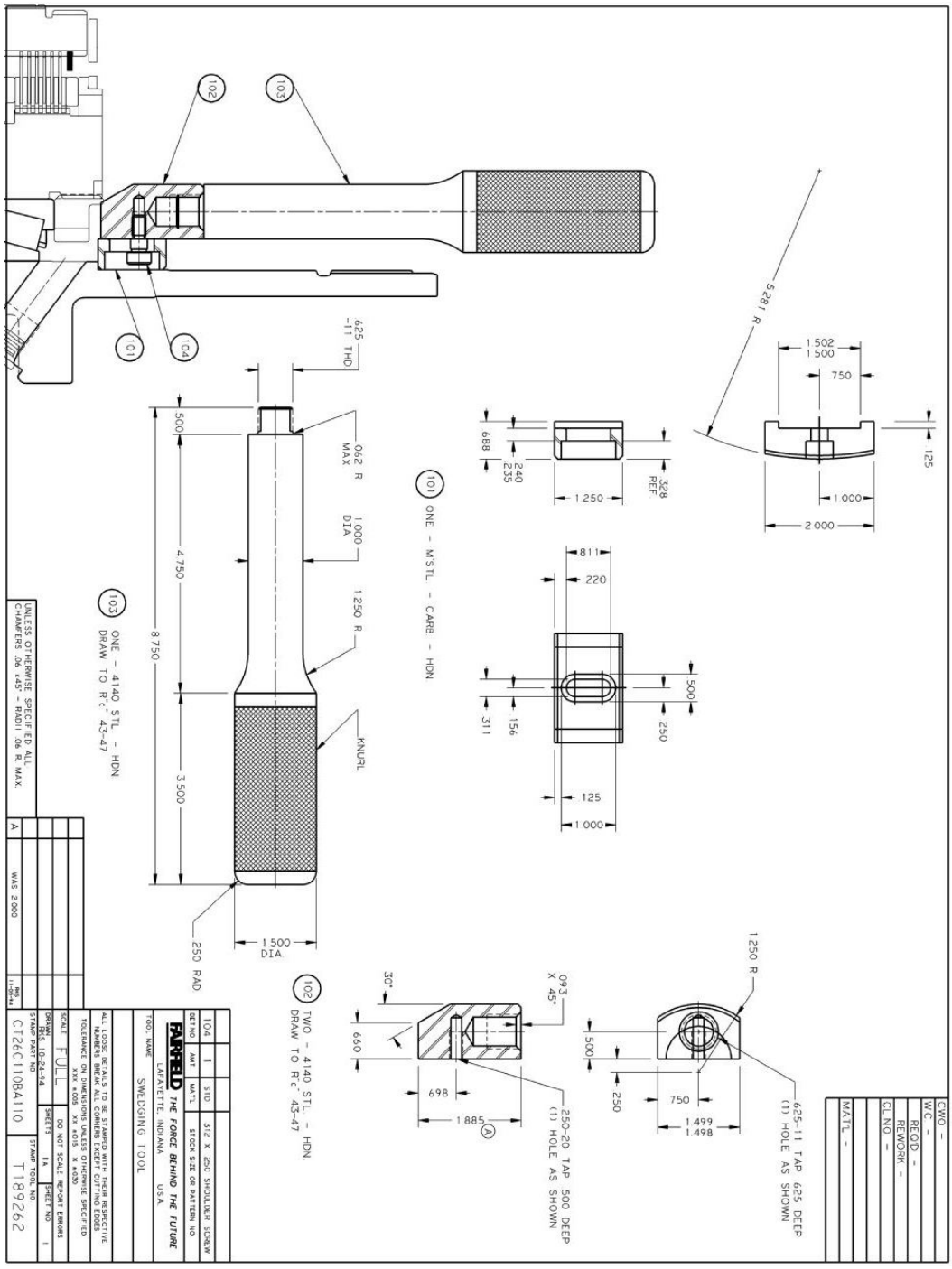
Number	Qty	Description
1A	1	SPINDLE
1B	1	FACE SEAL
1C	1	BEARING CUP
1D	1	BEARING CONE
1G	1	HOUSING
1E	1	BEARING CUP
1F	1	BEARING CONE
1J	1	BEARING NUT
2	1	THRUST SPACER
3A	1	PLANET GEAR SET
3B	5	CYLINDRICAL ROLLER BEARING
3C	5	EXTERNAL RETAINING RING
3D	10	INTERNAL RETAINING RING
5	1	RING GEAR
8A	1	CARRIER
8B	1	SUN GEAR
8C	2	EXTERNAL RETAINING RING
8D	3	PLANET GEAR
9	1	SUN GEAR
10A	1	CARRIER
10B	24	THRUST WASHER
10C	108	NEEDLE BEARING
10D	6	PLANET SHAFT
10E	6	GROOVE PIN
10F	3	PLANET GEAR
11	1	INPUT SHAFT
12	1	THRUST WASHER
13	1	THRUST WASHER
14	1	O-RING
15	1	COVER PLATE
16	8	HEX BOLT (.250-20,1.000) GRD 8
17	5	PIPE PLUG MAGNETIC
18	1	BRAKE INPUT
19	2	DRIVE SCREW
20	1	ID PLATE
21A	1	COUPLING
21B	1	EXTERNAL RETAINING RING

Number	Qty	Description
21C	3	INTERNAL RETAINING RING
21F	1	INTERNAL RETAINING RING
21E	1	COPLING SPRING
21D	1	THRUST SPACER
22	1	PIPE PLUG
15C	4	HEX BOLTS
15D	1	DISENGAGE CAP
15B	1	COVER CAP
15G	1	O-RING
15F	1	O-RING
15E	1	DISENGAGE ROD
18J	1	END PLATE
18F	1	O-RING
18G	1	O-RING
18H	1	BACK UP RING
18I	1	BACK UP RING
18L	1	THRUST PLATE
18A	*	SPRING
18B	6	SOCKET HEAD SCREW
18K	1	BREAK PISTON
18E	1	RETAINING RING
18D	7	ROTOR
18C	6	STATOR(LOBED)
24	1	ADAPTOR MOUNT
25	1	O-RING
26	2	BOLT
30	1	THRUST WASHER

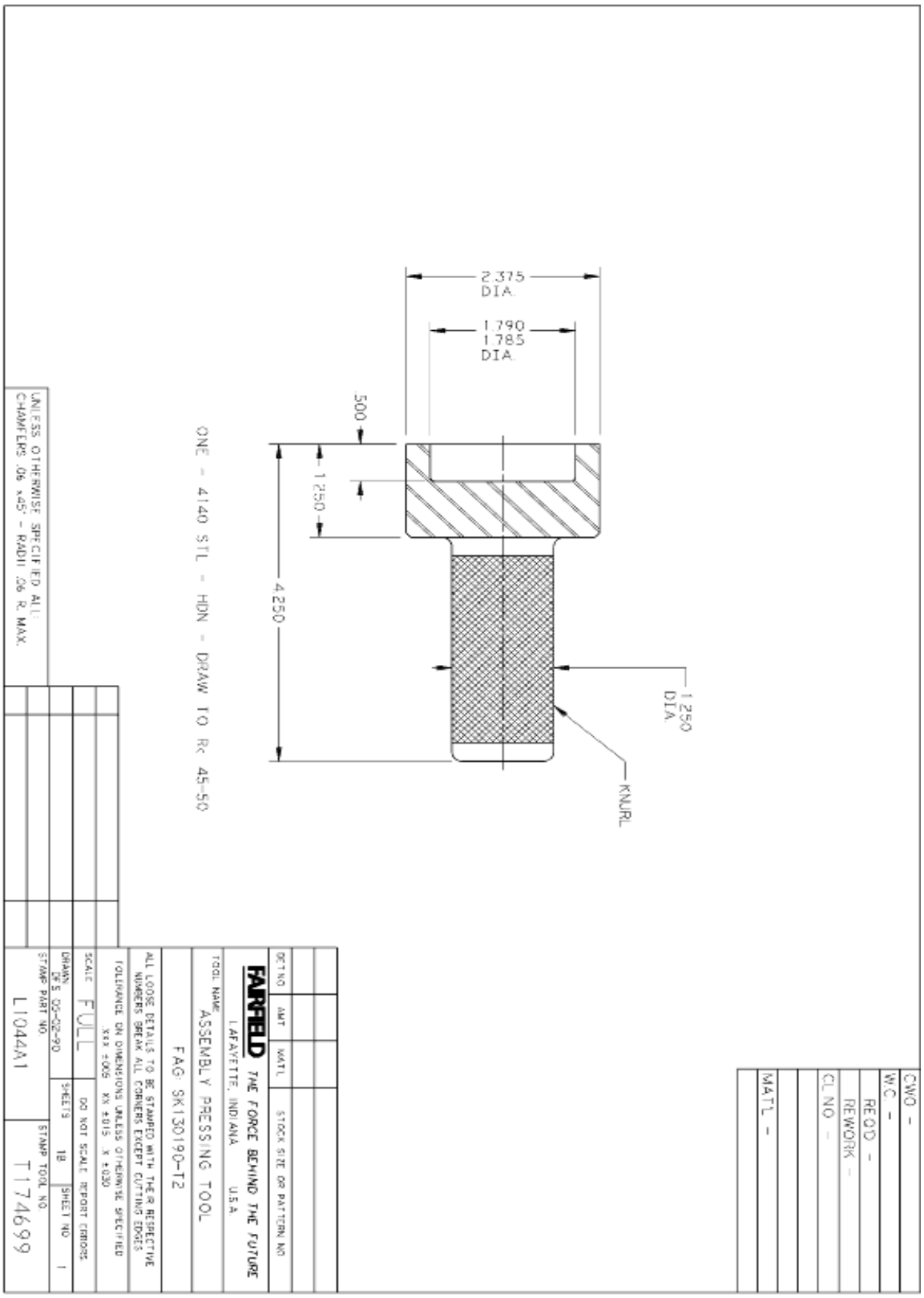
NOTE: * For Spring (18A) quantity refer Brake Chart under Brake Test in page 5.

Planetary Final Drive Repair Instructions
Assembly Tools

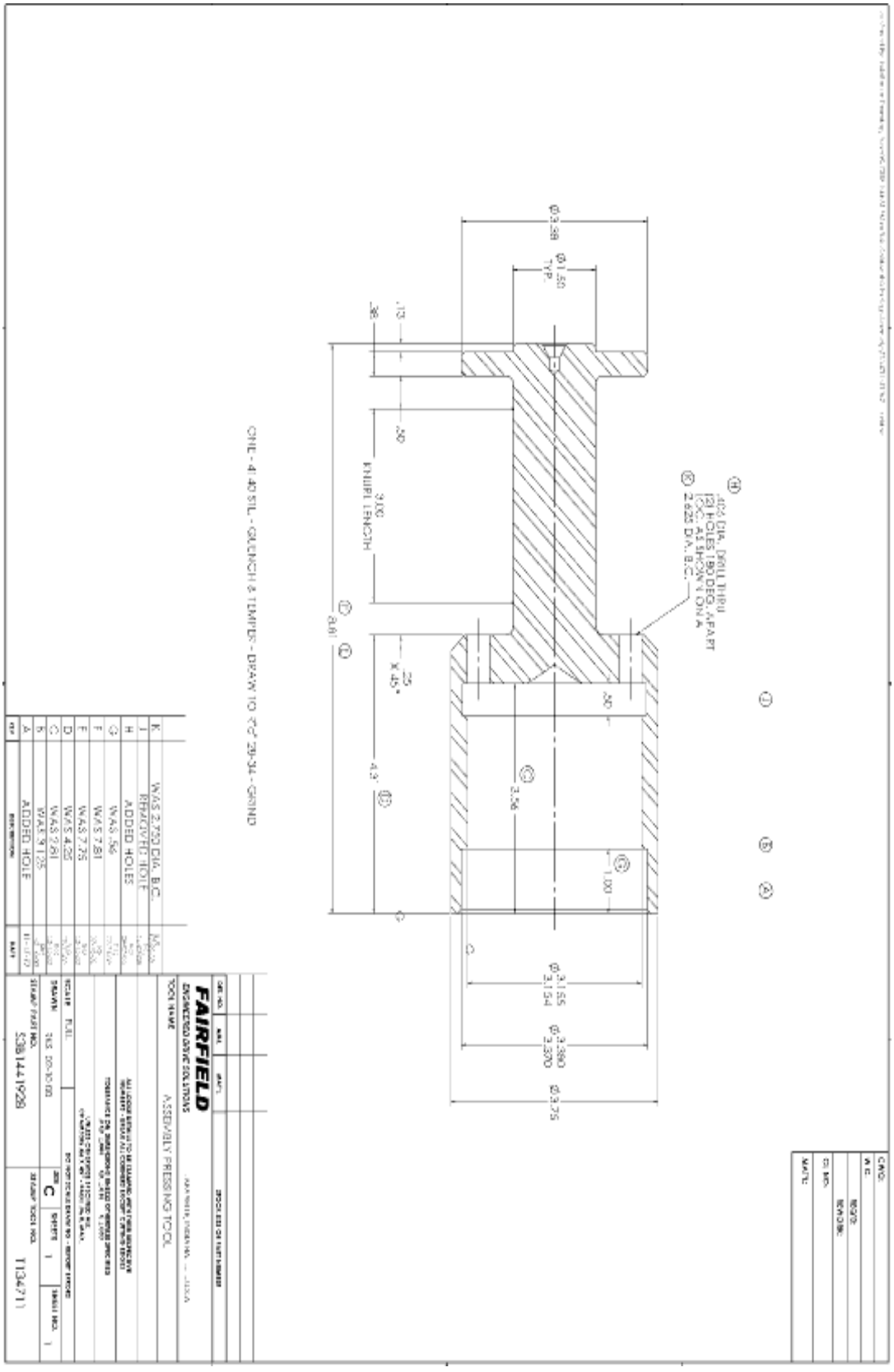
T189262 – SWEDGING TOOL



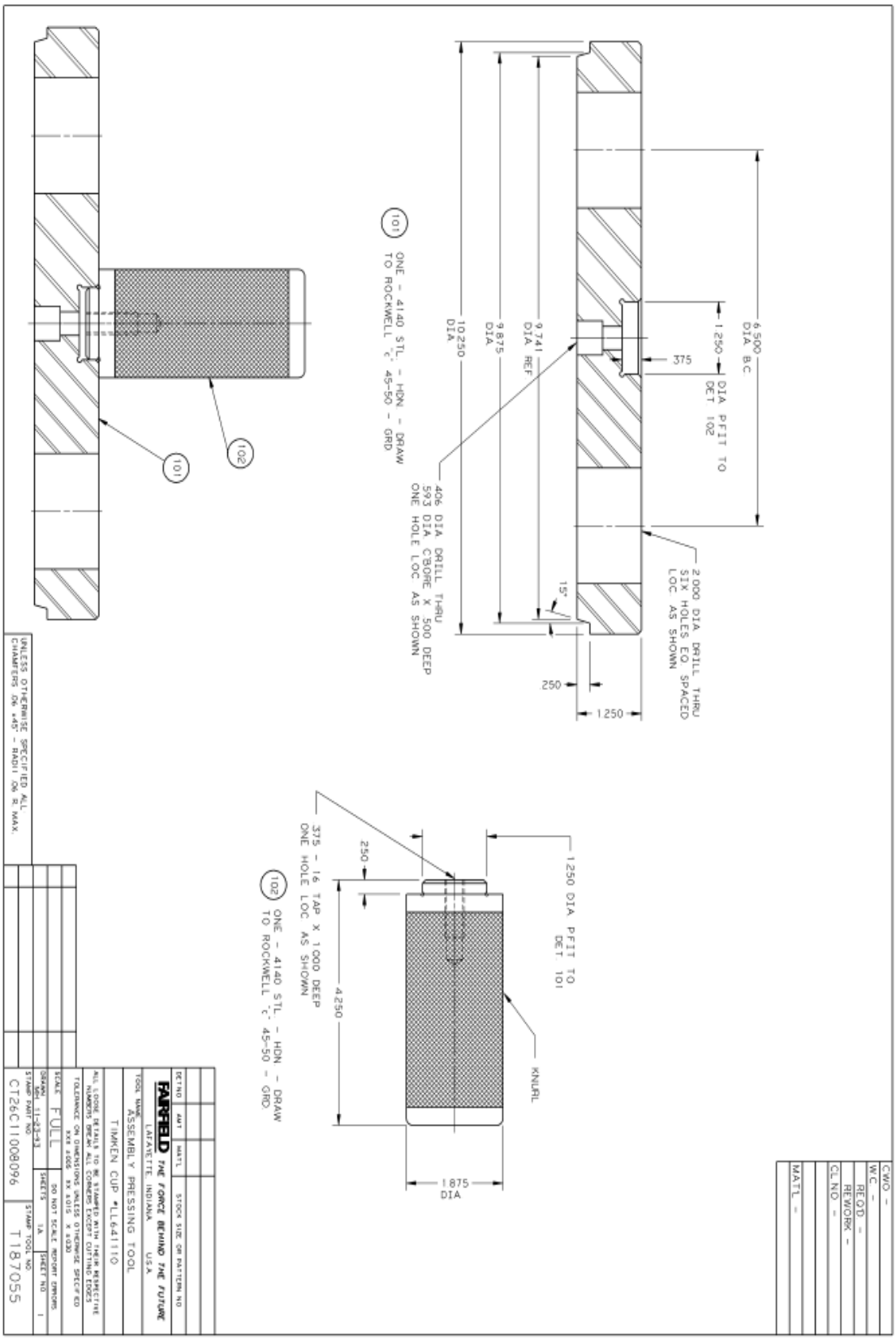
T174699 – ASSEMBLY PRESSING TOOL



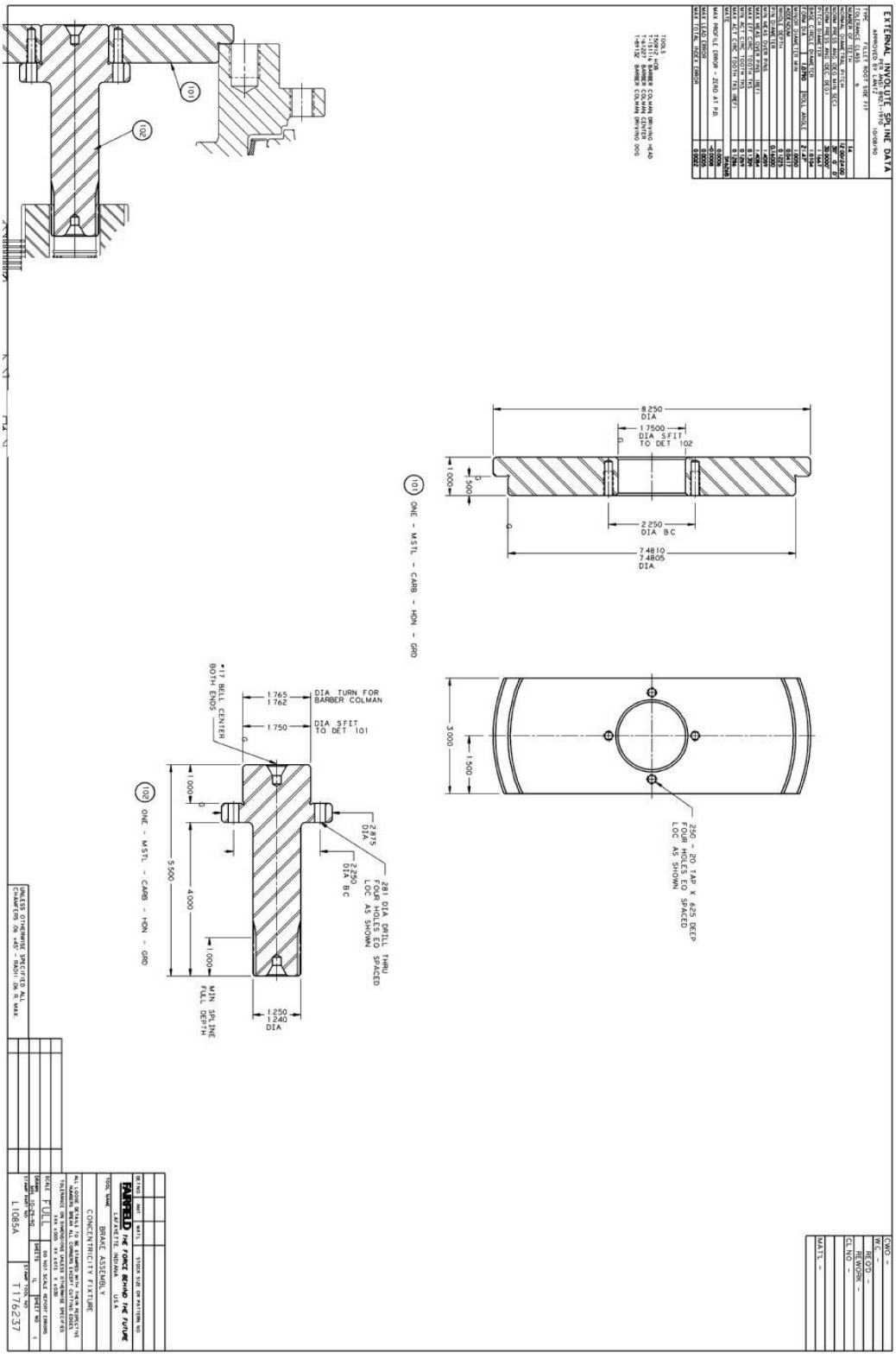
T134711 – ASSEMBLY PRESSING TOOL



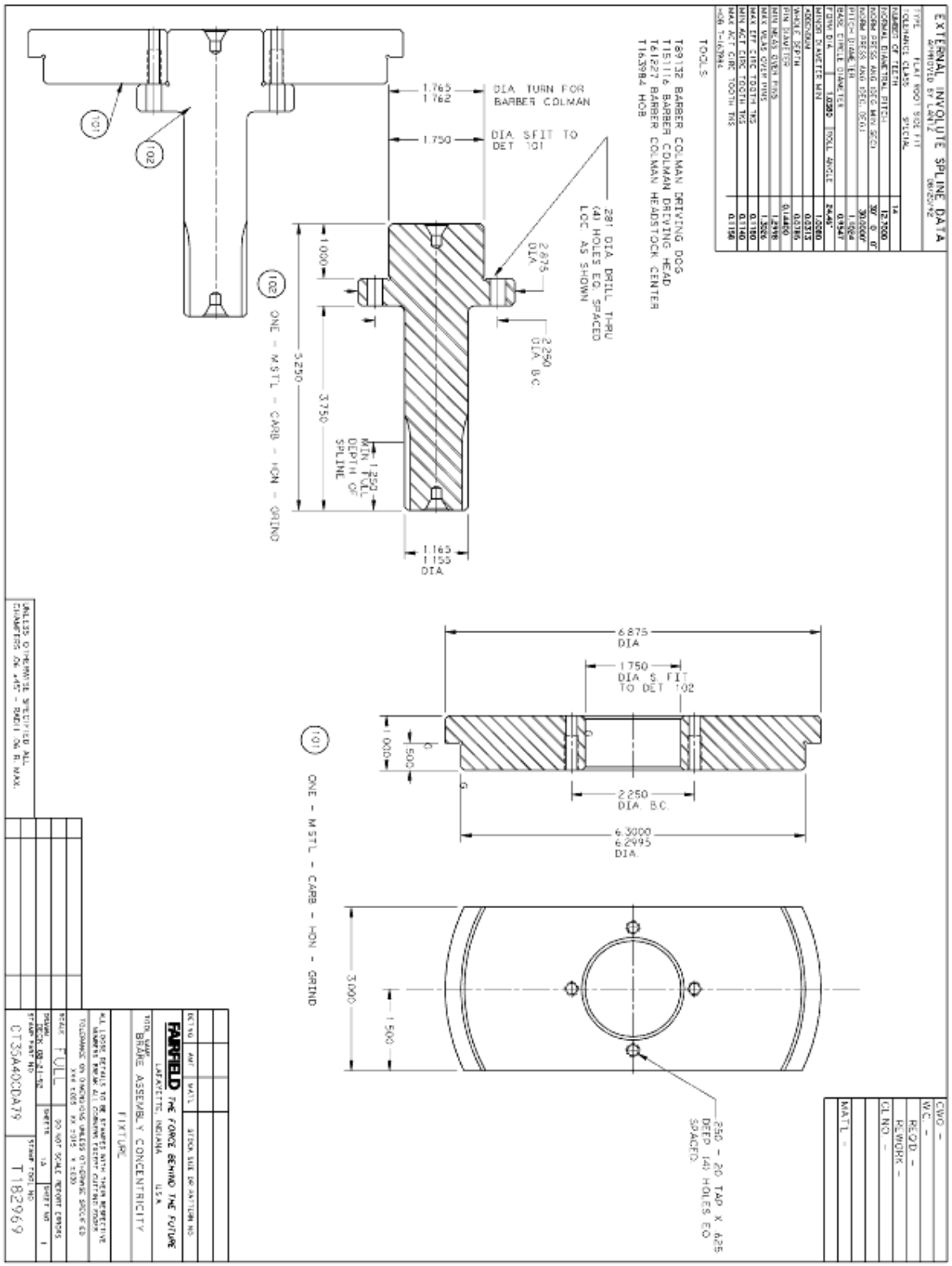
T187055 – ASSEMBLY PRESSING TOOL


6.500 DIA BC
1.250 DIA PFIT TO DET 102
.375
10.250 DIA
9.875 DIA
9.741 DIA REF
.406 DIA DRILL THRU .593 DIA C'BORE X .500 DEEP ONE HOLE LOC AS SHOWN
2.000 DIA DRILL THRU SIX HOLES EQ SPACED LOC AS SHOWN
15°
.250
1.250
(101) ONE - 4140 STL - HDN - DRAW TO ROCKWELL 'c' 45-50 - GRD
(102)
(101)
(102) ONE - 4140 STL - HDN - DRAW TO ROCKWELL 'c' 45-50 - GRD
.375 - 16 TAP X 1.000 DEEP ONE HOLE LOC AS SHOWN
.250
4.250
1.250 DIA PFIT TO DET 101
KNURL
1.875 DIA
UNLESS OTHERWISE SPECIFIED ALL CHAMFERS .06 x 45° - RADII .06 R. MAX.
CWO -
WC -
REQD -
REWORK -
CL NO -
MATL -
DETND
APPT
MATL
STOCK SIZE OR PATTERN NO
FAIRFIELD THE FORCE BEHIND THE FUTURE
LAFAYETTE INDIANA U.S.A.
TOOL NAME
ASSEMBLY PRESSING TOOL
TIMKEN CUP *LL641110
ALL LOOSE DETAILS TO BE STAMPED WITH THEIR RESPECTIVE NUMBERS BREAK ALL CORNERS EXCEPT CUTTING EDGES
TOLERANCE UNLESS OTHERWISE SPECIFIED
.XXX ±.005 .XX ±.015 X ±1/32
SCALE FULL
DRAWN MH 11-23-93
DO NOT SCALE REPORT ERRORS
STAMP PART NO
CT26C1100B096
SHEETS 1A
SHEET NO 1
STAMP TOOL NO
T187055

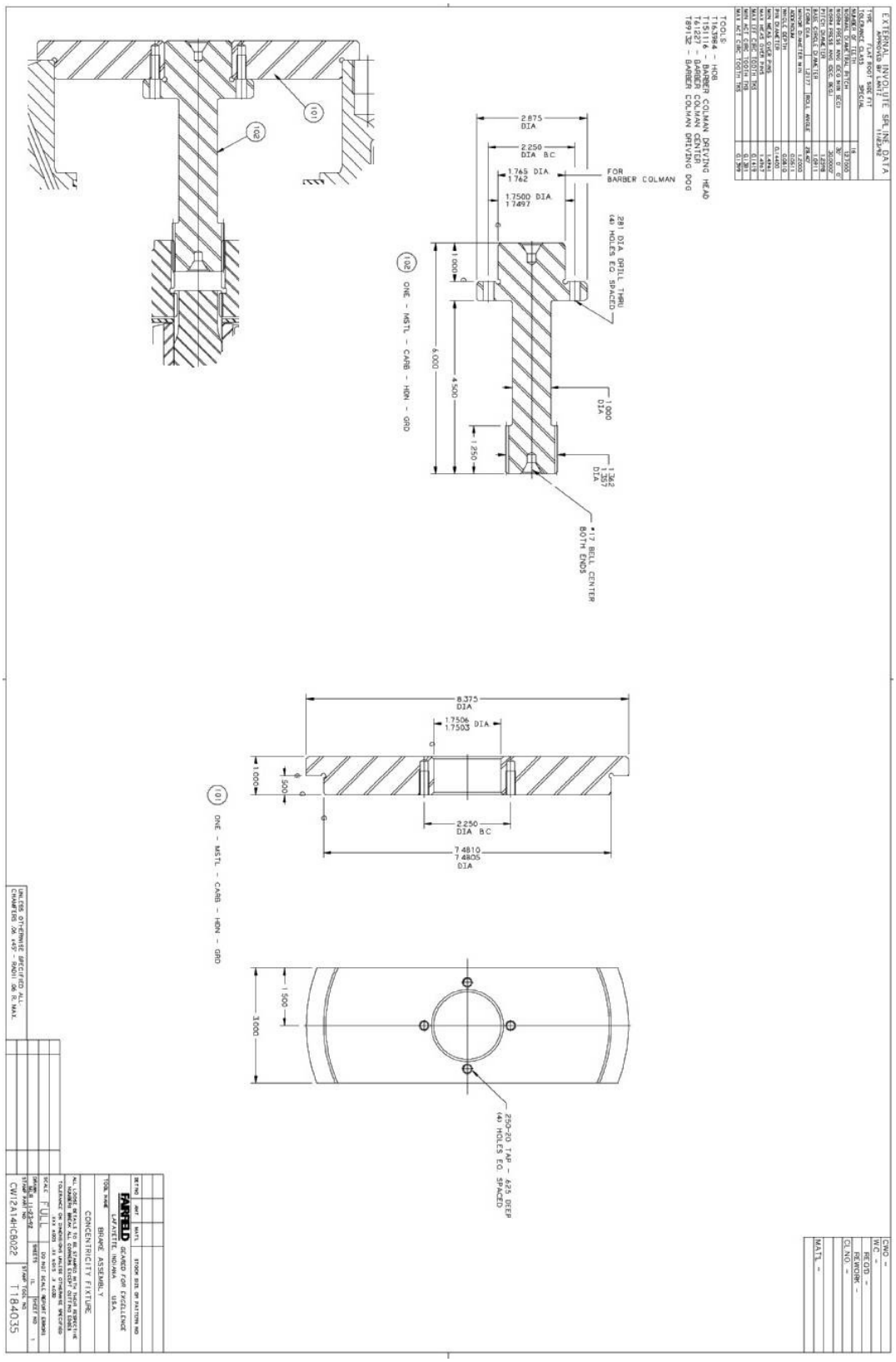
T176237 – ROLL CHECK TOOL



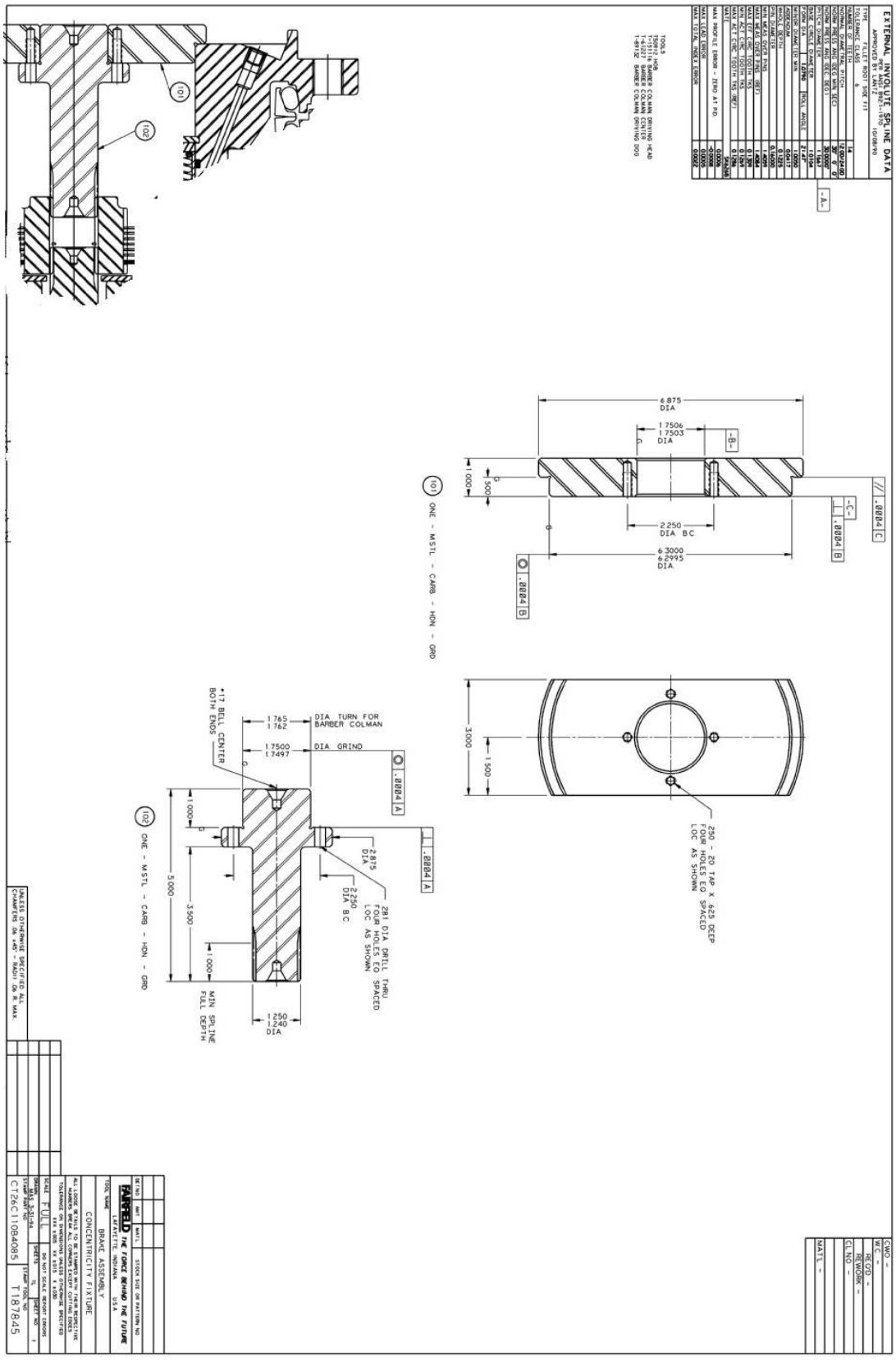
T182969 – ROLL CHECK TOOL



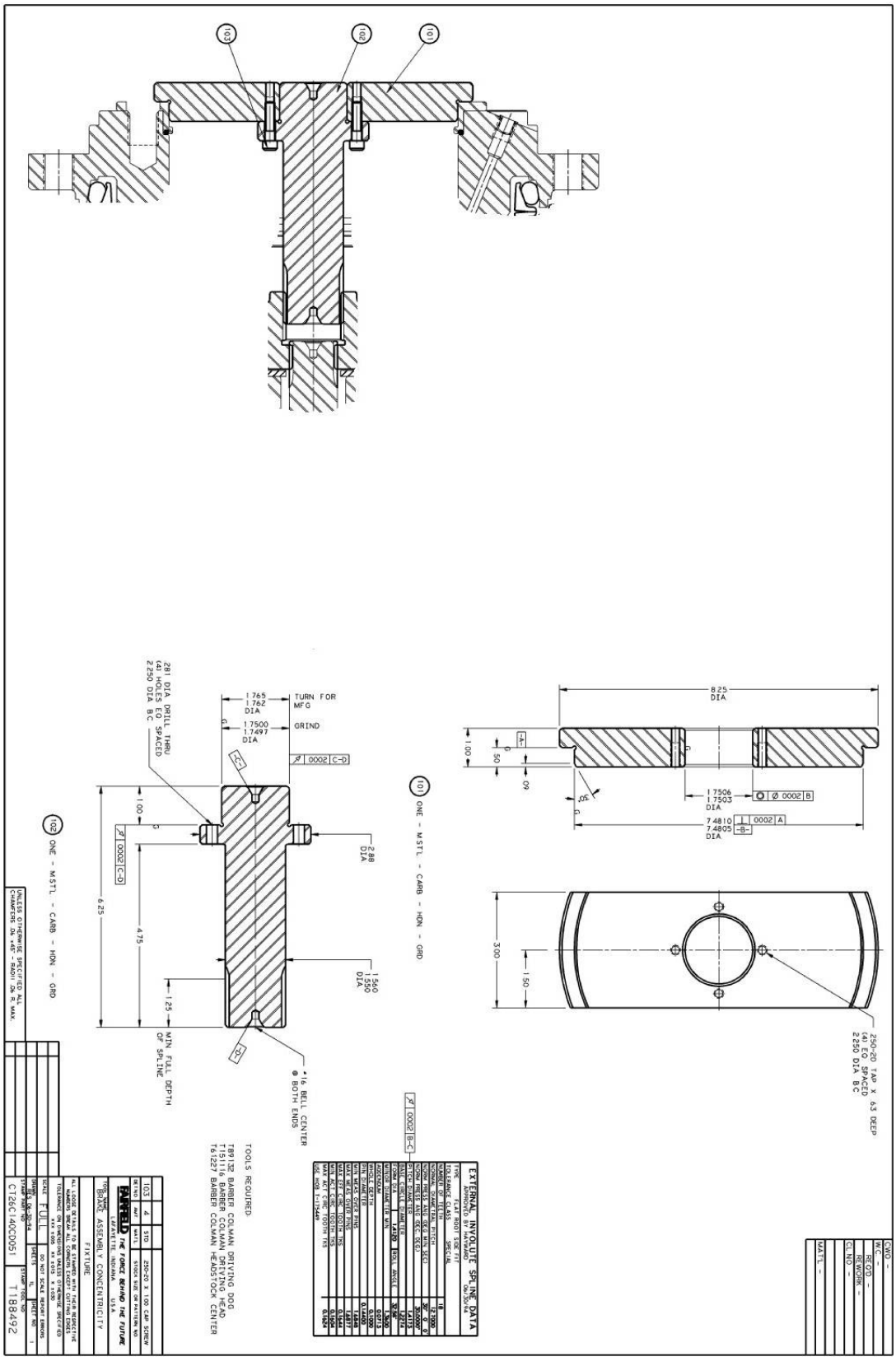
T184035 – ROLL CHECK TOOL



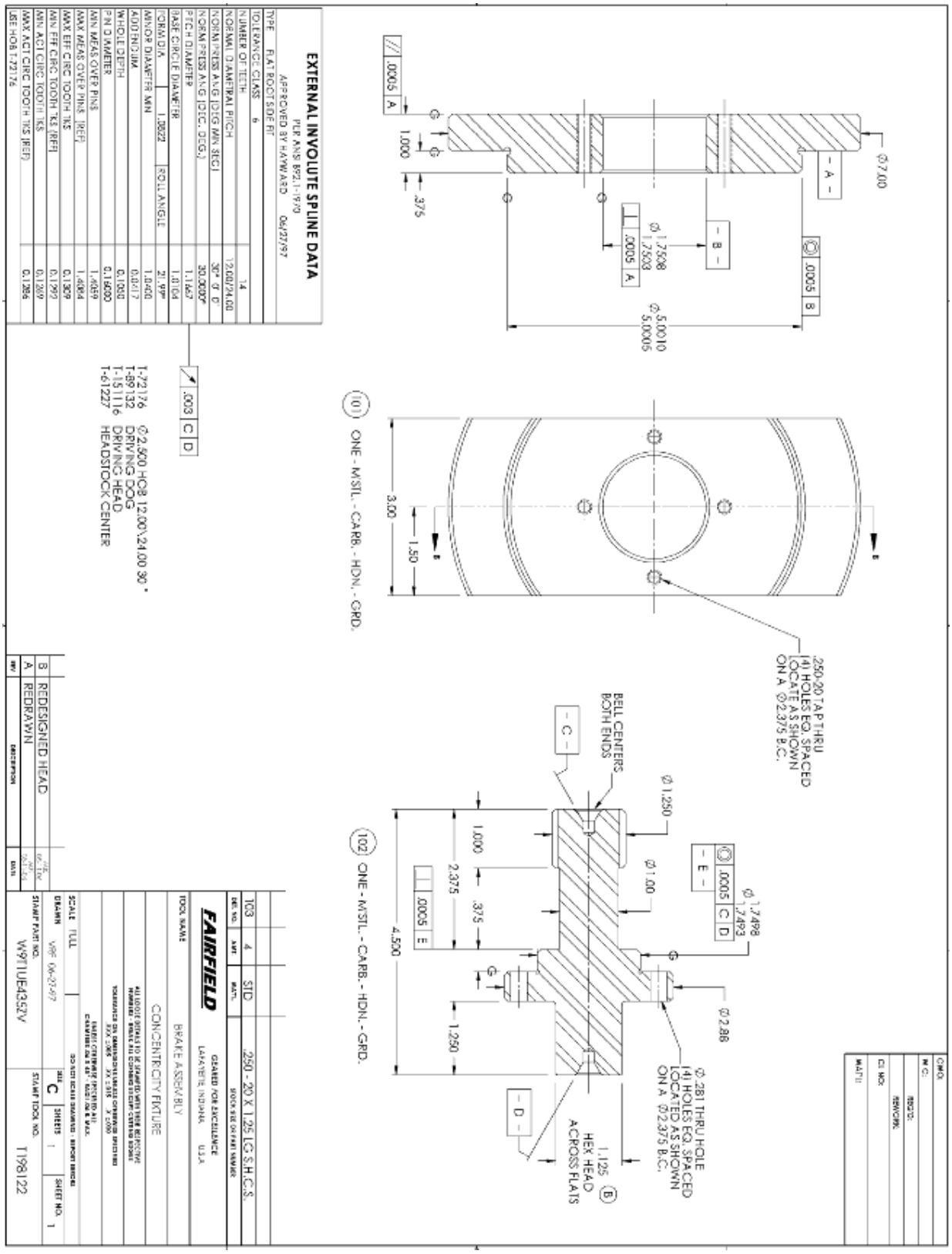
T187845 – ROLL CHECK TOOL



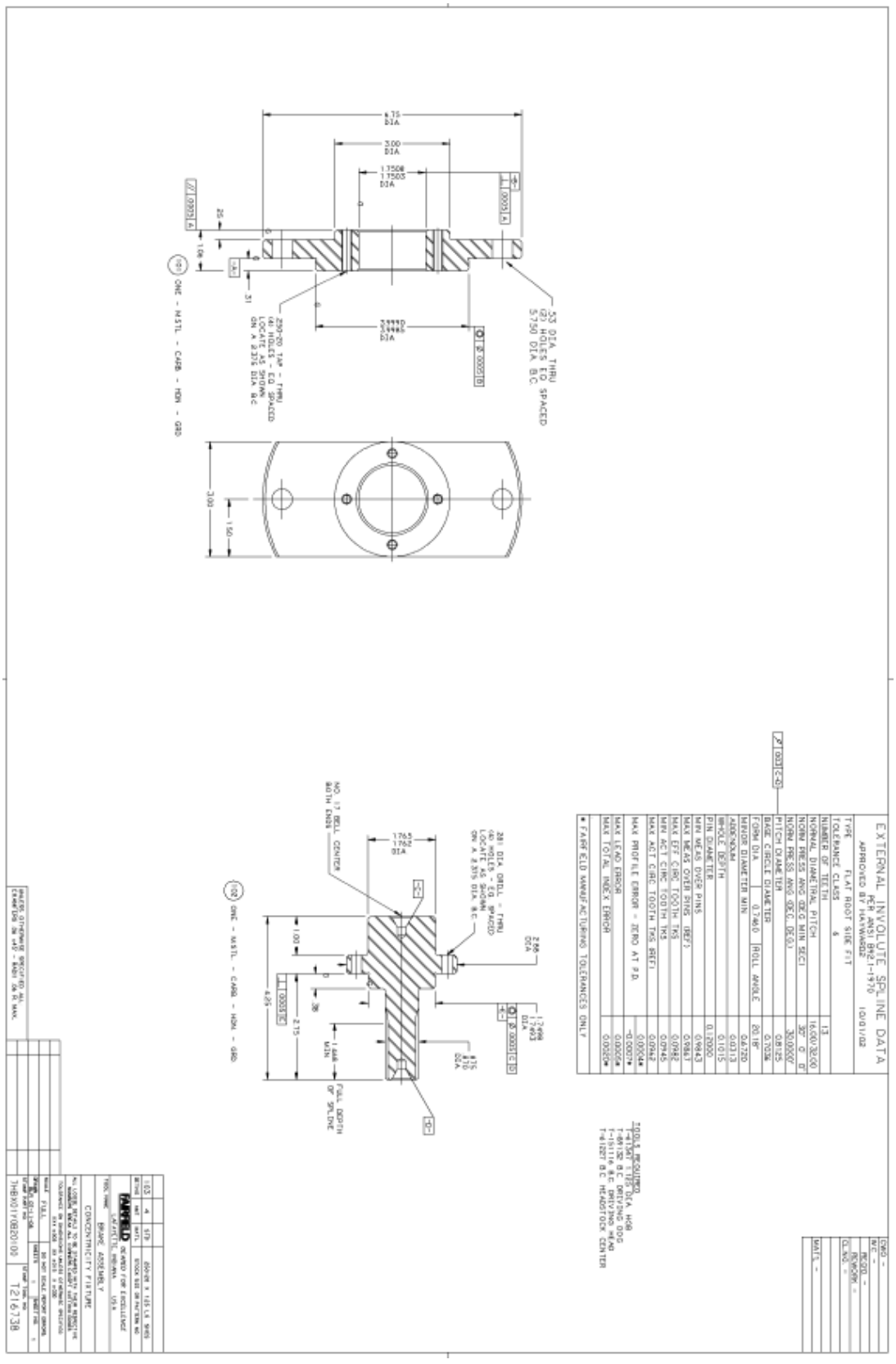
T188492 – ROLL CHECK TOOL



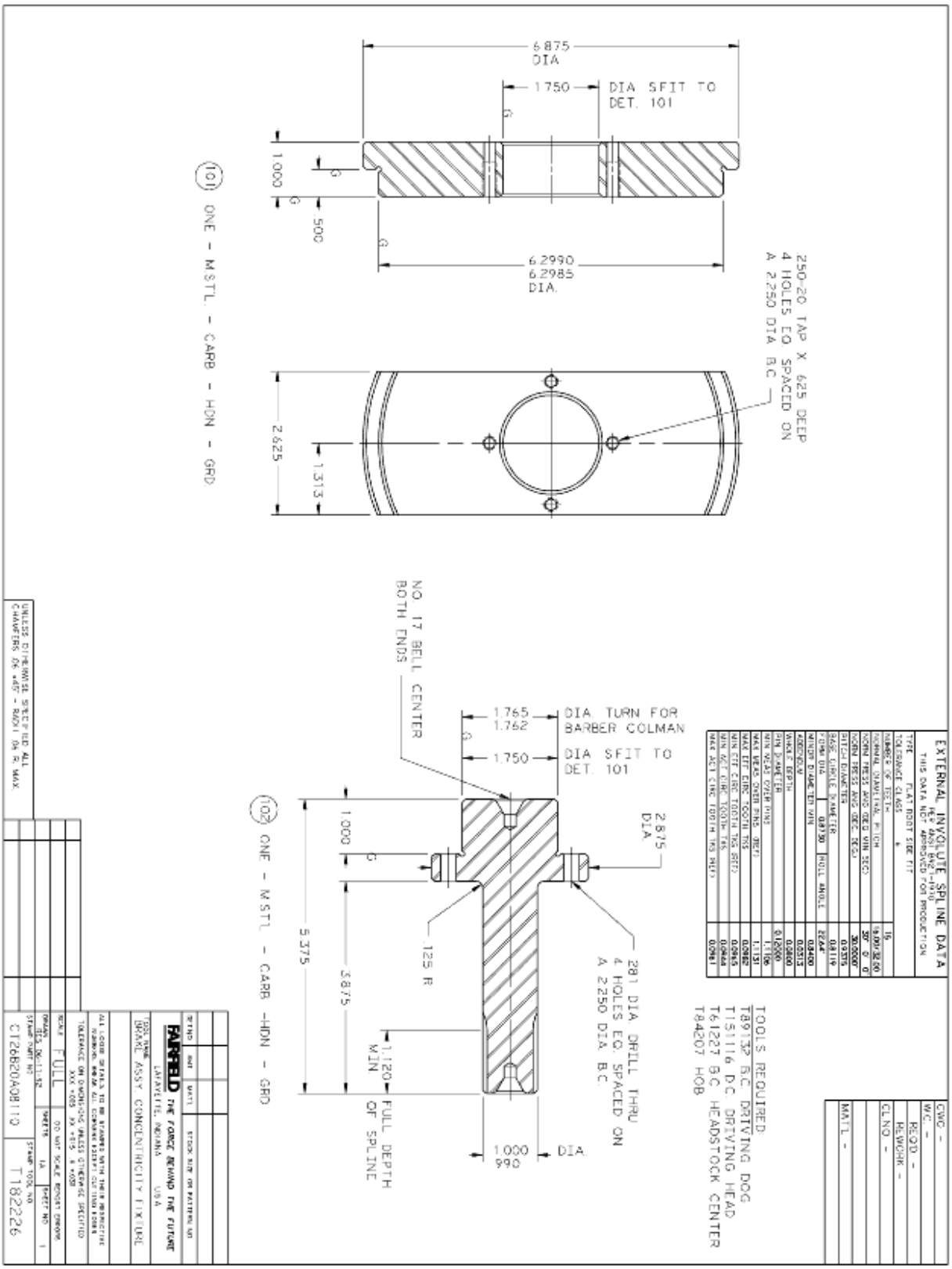
T198122 – ROLL CHECK TOOL



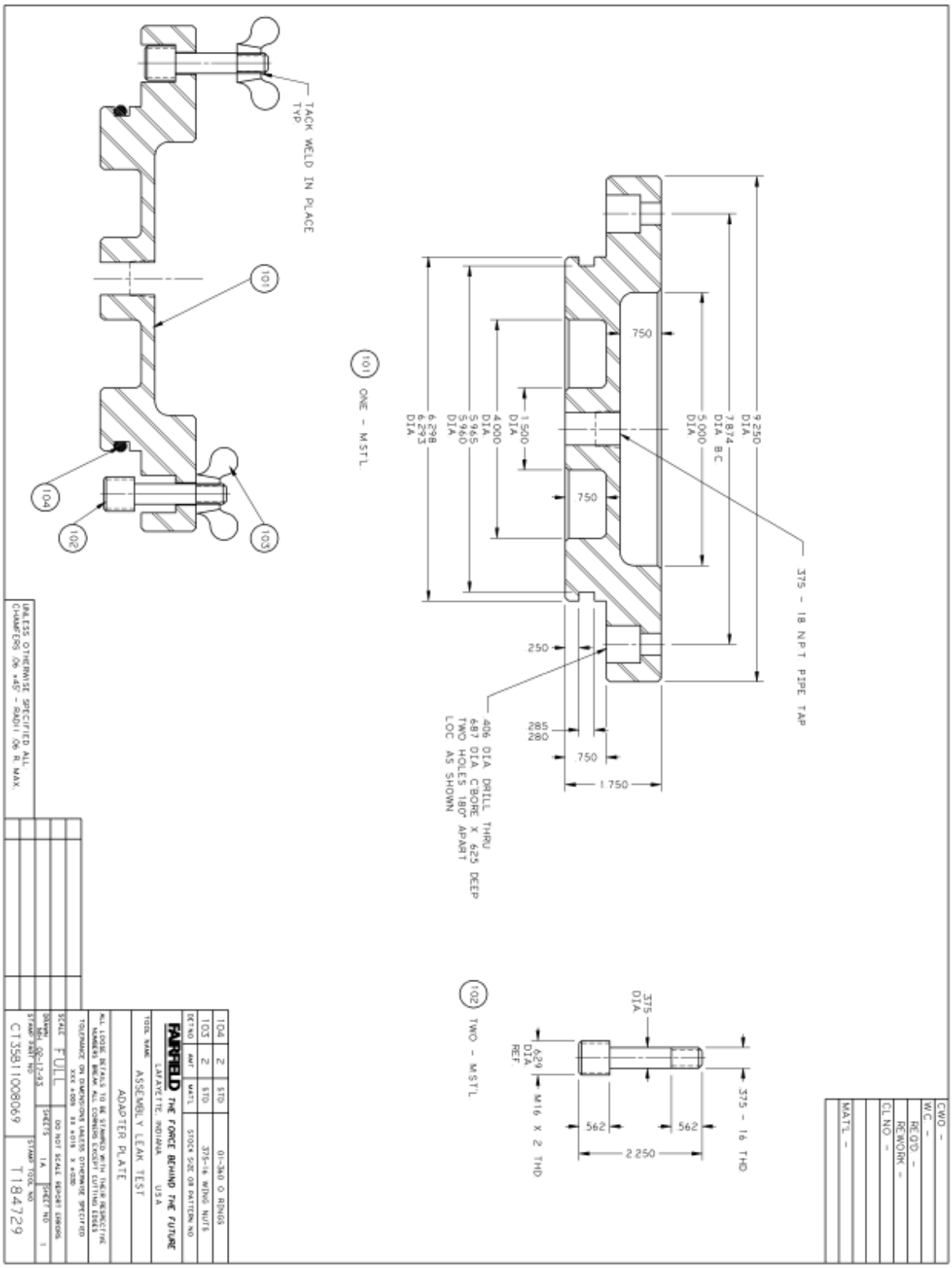
T216738 – ROLL CHECK TOOL


EXTERNAL INVOLUTE SPLINE DATA
PER ANSI B92.1-1970
10/01/02
TYPE FLAT ROOT SIDE FIT
TOLERANCE CLASS 6
NUMBER OF TEETH 13
NORMAL DIAMETRAL PITCH 16/32
NORM PRESS ANG (DEG MIN SEC) 30° 0' 0"
NORM PRESS ANG (DEG DEC) 30.00000°
PITCH DIAMETER 0.8125
BASE CIRCLE DIAMETER 0.7034
FORM DIA 0.7460 ROLL ANGLE 28.18°
MINOR DIAMETER MIN 0.6720
ADDENDUM 0.0313
WHOLE DEPTH 0.1015
PIN DIAMETER 0.12000
MIN MEAS OVER PINS 0.9843
MAX MEAS OVER PINS (REF) 0.9867
MAX EFF CIRC TOOTH THS 0.0982
MIN ACT CIRC TOOTH THS 0.0945
MAX ACT CIRC TOOTH THS (REF) 0.0962
MAX PROFILE ERROR - ZERO AT P.D. -0.00074 -0.00034
MAX LEAD ERROR 0.00054 0.00054
MAX TOTAL INDEX ERROR 0.00254 0.00254
* FAIRFIELD MANUFACTURING TOLERANCES ONLY
TOOLS REQUIRED
T-41561 1.125 DIA HUB
T-69132 B.C. DRIVING DOG
T-10114 B.C. DRIVING HEAD
T-41627 B.C. HEADSTOCK CENTER
.53 DIA. THRU 6 HOLES EQ. SPACED 5.750 DIA B.C.
28.0 DIA DRILL - THRU (6) HOLES - EQ. SPACED LOCATE AS SHOWN ON A 9.375 DIA B.C.
ONE - MSTL - CARB - HDN - GRD
MIN. 17 ROLL CENTER BOTH ENDS
FULL DEPTH OF SPLINE
UNLESS OTHERWISE SPECIFIED ALL CHAMFERS 45° x 45° - MAX OF 0.1 MAX.
FAIRFIELD
DESIGNED FOR EXCELLENCE
FAIRFIELD, INDIANA, USA
DRIVE ASSEMBLY
CONCENTRICITY FIXTURE
THIS DRAWING AND SPECIFICATIONS, AS AN UNPUBLISHED WORK, ARE THE PROPERTY OF FAIRFIELD MANUFACTURING COMPANY, INC. AND ARE NOT TO BE USED OR DISCLOSED WITHOUT WRITTEN PERMISSION.
DO NOT SCALE DRAWING
THB901V0820100
T216738

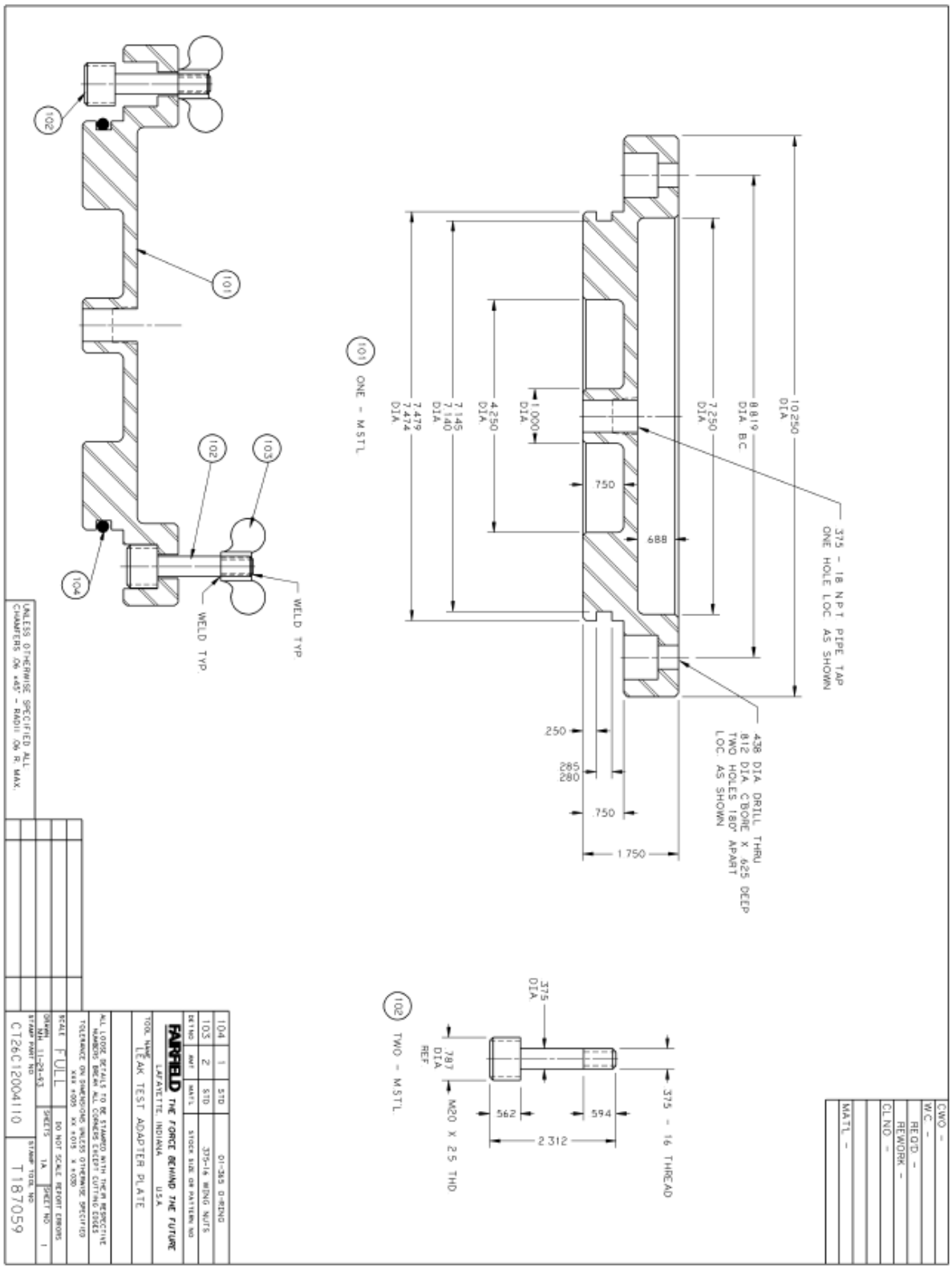
T182226 – ROLL CHECK TOOL



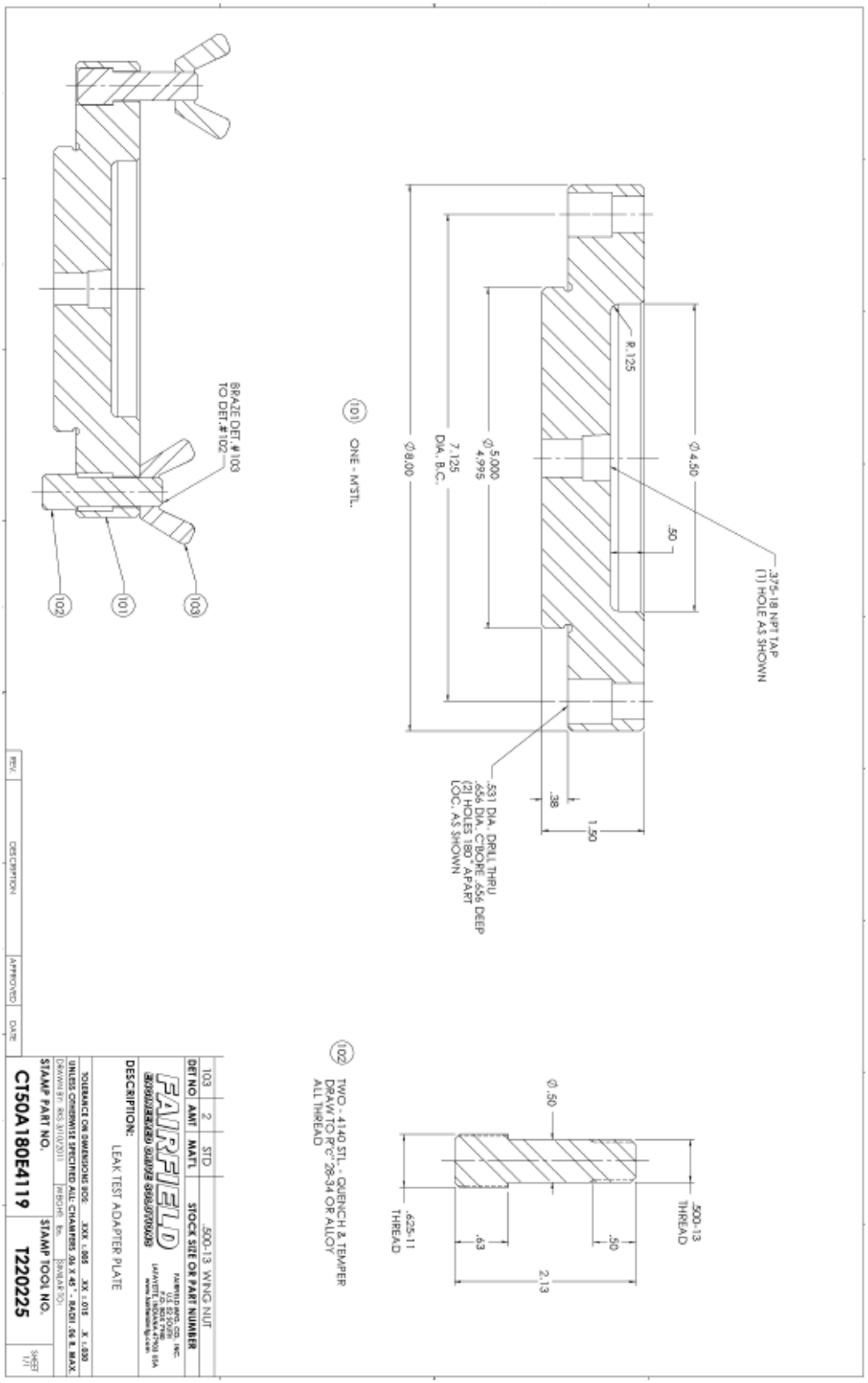
T184729 – LEAK CHECK TOOL



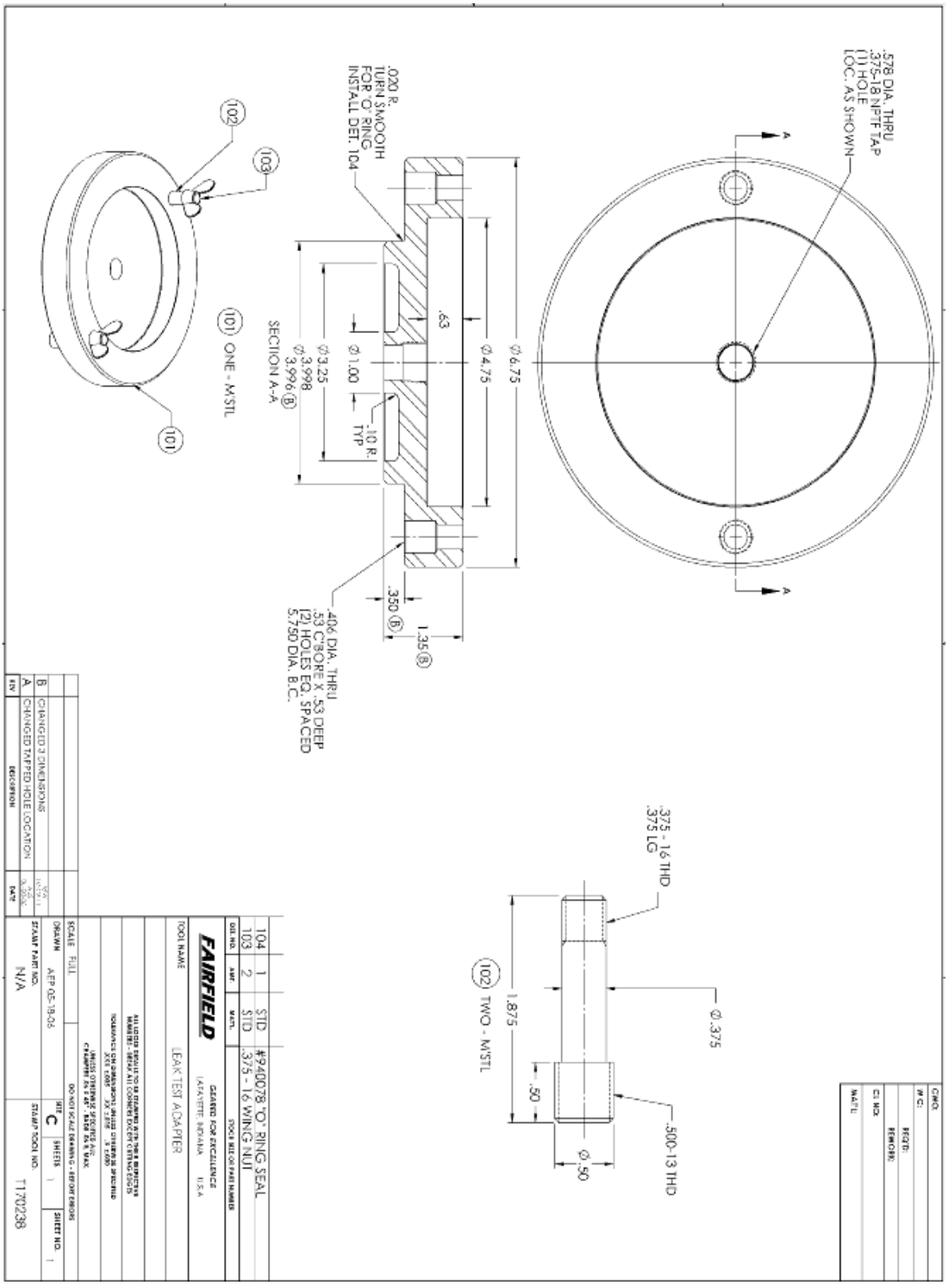
T187059 – LEAK CHECK TOOL



T220225 – LEAK CHECK TOOL



T170238 – LEAK CHECK TOOL



Planetary Final Drive Repair Instructions

Contact Information

With over 80 years of experience, Fairfield Manufacturing has become the largest U.S. non-captive producer of gears, custom gear assemblies, planetary final drives, and related gear products. Fairfield Manufacturing, headquartered in Lafayette, Indiana, is distinguished by our extensive design, manufacturing, and applications engineering capabilities. Our 500,000 square foot plant is a modern, fully equipped manufacturing facility that includes a full service heat treat department.

Our philosophy of synchronous engineering is a partnership that matches our best and brightest people with your people to evaluate your unique requirements, and develop products and assemblies that meet your needs.

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